



# Role of Innovation Strategy in the Business Growth of High-Technology SMEs in UK

Roopa Aruvanahalli Nagaraju

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# **Role of Innovation Strategy in the Business Growth of High-Technology SMEs in the UK**

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**September 2015**  
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# **Role of Innovation Strategy in the Business Growth of High-Technology SMEs in UK**

**By**

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**A thesis submitted to the University of Bedfordshire, in partial fulfilment of the  
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## Abstract

Innovative high-technology SMEs have become a major influencing factor in the success of any modern economy and they increasingly compete in the globalised world with limited resources. Previous research on SMEs at firm level has always taken into consideration the constraints of the resources that an SME faces and the implications of this on their performance and business growth. SMEs have to develop their own unique skills and capabilities, allocating their limited resources appropriately to be able to respond to the changes in the external business environment that pose risks to the success of their innovation and its commercialisation. Having an innovation strategy is very important: to have a clear goal and a path to achieve the set goal. This helps high-technology SMEs to decide which factors can influence the success of their innovations, leading to business growth by developing dynamic capabilities to respond to the external changes by allocating their resources at their disposal.

This thesis is an empirical analysis of innovation strategy and its role in the business growth of high-technology SMEs. This research study is carried out at firm level. It draws on Resource-Based View and Dynamic Capability theory to explore innovation strategy factors contributing to the better performance of the firm. Four hypotheses were proposed based on the theoretical framework developed through the literature review. They were tested using empirical data. The primary data were collected using quantitative methods through survey questionnaire. Data was collected from 106 high-technology SMEs in the UK. Technological factor, marketing factor, entrepreneurial factor and risk from the business environment were identified as four important factors which are part of an innovation strategy.

The results of the study suggest three revised factors: technology, entrepreneurial and government-related risk factors. The initial risk related to business environment was amended to government-related risk factors based on the measurement variables which were loaded to the factor. However, one hypothesis based on the marketing factor failed to support the proposed positive influence on business growth and hence rejected. This calls for further research on the marketing factor in high-technology SMEs. This study recognises the reason behind this paradoxical result, which could be the nature of the high-technology firms participating in this study, which are more dependent on technology-push

rather than marketing pull and they do not confirm with the established norms of marketing for the business growth of their firm.

This study contributes to the development of knowledge and practice at multiple levels. The research developed a theoretical framework to establish the innovation strategy factors and its influence on business growth and this is validated through empirical data. At the practice level, the results of the study could be used by high-technology SMEs in the UK, and any other high-technology SMEs which are based in a similar economy and business environment, to have better information about innovation strategy. The study could also help policy makers, propose better policy to support innovation of high-technology SMEs in UK.

## Dedication

To all those who have been an inspiration to me at various stages of my life and have been instrumental in shaping my personal as well as professional growth.

# Table of Contents

<b>Abstract.....</b>	<b>iii</b>
<b>Dedication .....</b>	<b>v</b>
<b>Table of Contents .....</b>	<b>vi</b>
<b>List of Tables .....</b>	<b>xi</b>
<b>List of Figures.....</b>	<b>xiii</b>
<b>Acknowledgements.....</b>	<b>xiv</b>
<b>Declaration.....</b>	<b>xv</b>
<b>List of Abbreviations.....</b>	<b>xvi</b>
<b>Conference paper .....</b>	<b>xvii</b>
<b>CHAPTER 1: INTRODUCTION.....</b>	<b>1</b>
1.1. Background of the Study.....	1
1.2. Statement of the Problem and Motivation for the Research.....	3
1.3. Aims, Objectives and Research Questions.....	3
1.3.1. Aim.....	4
1.3.2. Research questions .....	4
1.3.3. Objectives.....	5
1.4. Context of this Study.....	5
1.5. Significance of the Research .....	8
1.6. Research Boundaries .....	9
1.6.1. The larger context of the study.....	9
1.6.2. Level of participants.....	9
1.6.3. The size of the firm .....	9
1.6.4. Sector.....	10
1.6.5. Geographic limit.....	10
1.6.6. Research methodology and process .....	10
1.7. Structure of the Thesis.....	10
<b>CHAPTER 2: LITERATURE REVIEW .....</b>	<b>13</b>
2.1. Introduction.....	13
2.2. Background .....	13
2.3. Innovation and Evaluations of Various Theories .....	15
2.3.1. Definition of Innovation.....	16
2.3.2. Theoretical background.....	18

2.3.3. Theoretical models of RBV and Dynamic capability.....	21
2.3.4. Dimensions of innovation .....	26
2.3.5. Radical vs. Incremental Innovation.....	26
2.3.6. Marketing and Technological capabilities .....	28
2.3.7. Open Technological Innovation .....	29
Marketing and Technological capabilities .....	31
2.3.8. Innovation measurements.....	31
2.4. Innovation Strategy .....	35
2.4.1. Definition of Innovation Strategy.....	39
2.4.2. Resource-Based View and Innovation Strategy .....	41
2.4.3. Innovation Strategy and Dynamic Capabilities .....	43
2.4.4. Innovation strategy taxonomies.....	46
2.5. Business Growth and Performance .....	48
2.6. High-Technology SMEs.....	49
2.7. Indicators and Relationships between Indicators .....	50
2.8. Theoretical Framework Development.....	54
2.8.1. Theoretical foundation of the study.....	55
2.8.2. Technological Factor.....	58
2.8.3. Marketing Factors .....	60
2.8.4. Entrepreneurial factor.....	62
2.8.5. Risk from Business Environment.....	65
2.8.6. Business Growth .....	67
2.9. Theoretical Framework .....	68
2.10. Conclusion.....	69
<b>CHAPTER 3: RESEARCH METHODOLOGY .....</b>	<b>70</b>
3.1. Introduction.....	70
3.2. Research Philosophies and Paradigms .....	71
3.2.1. Ontological concerns.....	73
3.2.2. Epistemological concerns.....	73
3.2.3. Axiological concerns.....	74
3.2.4. Positivism versus Interpretivism .....	75
3.2.5. Research Philosophical Design .....	78
3.2.6. Rationale for adopting the positivist paradigm .....	79
3.3. Research Approach .....	81



3.3.1. Deductive approach.....	81
3.3.2. Inductive approach .....	82
3.3.3. Approach chosen.....	82
3.4. Research Strategy .....	82
3.4.1. Research design.....	83
3.4.2. Study design .....	84
3.4.3. Survey method.....	85
3.4.4. Questionnaire design .....	87
3.5. Questionnaire Validity and Reliability.....	89
3.5.1. Validity.....	89
3.5.2. Face validity .....	90
3.5.3. Content validity .....	91
3.5.4. Reliability .....	91
3.5.5. Appropriate language .....	92
3.5.6. Questionnaire structure .....	92
3.5.7. Survey length.....	97
3.5.8. Pilot study.....	97
3.5.9. Follow-ups.....	98
3.5.10. Incentives .....	98
3.6. Research Ethics and Data Collection .....	99
3.6.1. High-Technology SMEs.....	99
3.6.2. Sample.....	100
3.6.3. Sample size.....	101
3.6.4. Data collection and Data Aanalysis.....	101
3.7. Conclusion.....	102
<b>CHAPTER 4: ANALYSIS AND RESULTS .....</b>	<b>103</b>
4.1. Questionnaire as Data Collection Instrument.....	103
4.1.1. The population of the study.....	103
4.1.2. Data collection.....	103
4.2. Data Entry and Coding.....	106
4.2.1. Identical Sample .....	106
4.3. Descriptive Analysis .....	107
4.3.1. Profile of the respondents and the firms.....	107
4.3.2. Firm characteristics .....	108

4.4. Data Screening and Preparation .....	110
4.4.1. Missing values.....	110
4.4.2. The extent of missing data.....	111
4.4.3. Missing data pattern .....	112
4.4.4. Missing data treatment .....	113
4.4.5. Outliers and multivariate Normality test.....	114
4.5. Preliminary Statistical Analysis .....	115
4.5.1. Exploratory factor analysis versus confirmatory factor analysis.....	115
4.5.2. Principle Component Analysis (PCA) and Factor Analysis (FA).....	116
4.5.3. Factor Analysis.....	118
4.5.4. Study design .....	118
4.5.5. Factor extraction method:.....	118
4.5.6. Rotation of factors and its interpretation.....	121
4.5.7. The significance of the factor loading.....	122
4.5.8. EFA for Innovation Strategy .....	123
4.5.9. Multivariate test for assumption.....	124
4.6. Multiple Regression Analysis .....	125
4.6.1. Sample size and selection of variables .....	126
4.6.2. Assumptions of Multiple Regression Analysis .....	128
4.6.3. Linearity test.....	130
4.6.4. Colinearity test .....	130
4.7. Hypothesis Testing.....	131
4.8. Conclusion.....	132
<b>CHAPTER 5: DISCUSSION.....</b>	<b>134</b>
5.1. Introduction.....	134
5.2. Discussion of the Statistical Analysis .....	134
5.3. Technological Factors and Business Growth .....	135
5.4. Entrepreneurial Factors and Business Growth .....	137
5.5. Government-related Risk Factors and Business Growth.....	141
5.6. Marketing Factors and Business Growth .....	144
5.7. Business Growth .....	148
5.8. Conclusion.....	149
<b>CHAPTER 6: CONCLUSION AND RECOMMENDATIONS .....</b>	<b>150</b>
6.1. Revisiting the Research Background and Research Objectives .....	150
6.2. Research Approach .....	151

6.3. Summary of the Key Research Findings .....	152
6.3.1. Identification of research gaps .....	152
6.3.2. A proposed model for innovation strategy and its influence on business growth .....	153
6.4. Research Contributions to Theory and Practice .....	155
6.4.1. Theoretical Contributions.....	155
6.4.2. Empirical contribution.....	157
6.5. Limitations of the Study .....	158
6.6. Research Recommendations .....	160
<b>References .....</b>	<b>162</b>
<b>Appendix A: SIC Codes used in the study .....</b>	<b>189</b>
<b>Appendix B: Cover letter sent with postal mail survey questionnaire .....</b>	<b>193</b>
<b>Appendix C: Questionnaire (Final version) .....</b>	<b>194</b>
<b>Appendix D: Reminder Letter to follow up on the participation .....</b>	<b>201</b>
<b>Appendix E: Copy of an email sent with online questionnaire link.....</b>	<b>202</b>

## List of Tables

Table 2.1	Definitions of resource-based view and dynamic capabilities of the firm
Table 2.2	Abernathy and Clark's Model
Table 2.3	Innovation models and its relation to the RBV and Dynamic Capabiltiy theory
Table 2.4	Definitions of Innovation Strategy
Table 2.5	Innovation Indicators and their literature source
Table 2.6	Innovation Strategy Indicators and their literature source
Table 2.7	Performance Indicators and their literature source
Table 2.8	Business Growth Indicator and their literature source
Table 3.1	Philosophical differences between positivist and interpretivist approaches
Table 3.2	Overview of the Positivist and Interpretivist Paradigms
Table 3.3	Research Focus of the study
Table 3.4	Positivist philosophical paradigm of the study
Table 3.5	Methodology of previous studies
Table 3.6	Details of the company and the respondent
Table 3.7	Definitions of Innovation
Table 3.8	Part 4 Statements
Table 3.9	Categories of SMEs and their ceilings for three determining factors
Table 4.1	Summary of responses to the survey questionnaire
Table 4.2	Independent Samples Test for Employee Numbers - Online and Mail surveys
Table 4.3	Summary of the job title of the respondents
Table 4.4	Summary of the age of the participating company
Table 4.5	Summary of the employee number in the participating firms
Table 4.6	Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity results
Table 4.7	Rotated component matrix for Innovation Strategy and Business Growth
Table 4.8	Reliability statistics of each factor
Table 4.9	Summary of Correlation Matrix
Table 4.10	Descriptive Statistics for new factors
Table 4.11	Summary of Rsquare value based on sample size
Table 4.12	Multiple regression model summary [IV: Innovation Strategy]
Table 4.13	Multiple Regression coefficients [DV: Business Growth]
Table 5.1	Technological variables in order of loading strength
Table 5.2	Entrepreneurial variables in order of loading strength

Table 5.3	Government-related risk variables in order of loading strength
Table 5.4	Marketing variable in order of loading strength
Table 5.5	Business growth variable in order of loading strength

## List of Figures

- Figure 2.1 Stages of Innovation (Smith, 2010)
- Figure 2.2 The relationship between traditional “strength-weaknesses-opportunity-threat” analysis (Barney, 1991)
- Figure 2.3 Resource- Based View
- Figure 2.4 The Logical Structure of the Dynamic Capabilities Framework
- Figure 2.5 Radical and incremental innovation model (Holan and Patricia, 2013)
- Figure 2.6 Open technological innovation paradigm
- Figure 2.7 Results from Business Source Premier for Academic Journals on Innovation Strategy
- Figure 2.8 Results from Discover Search Engine for various publications on Innovation Strategy
- Figure 2.9 Dynamic Capabilities Model
- Figure 2.10 Theoretical foundation for the study
- Figure 2.11 The theoretical framework to determine the relationship between innovation strategy and business growth
- Figure 3.1 The framework of philosophical design
- Figure 3.2 Research process in inductive and deductive approaches
- Figure 3.3 Social research methods (Bryman, 2008: 161)
- Figure 4.1 Missing value patterns
- Figure 4.2 Scree test plot
- Figure 6.1 Final version of the theoretical model

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Finally to the Almighty, the supreme spiritual power, who is guiding me and will always guide me.

## Declaration

I declare that this thesis is my own unaided work. It is being submitted in partial fulfilment of the degree of Doctor of Philosophy, at the University of Bedfordshire. It has not been submitted before for any degree or examination in any other University.

*Name of the Student*

*Signature*

Roopa Aruvanahalli Nagaraju



## List of Abbreviations

CFA	Confirmatory Factor Analysis
EFA	Exploratory Factor Analysis
FA	Factor Analysis
KMO	Kaiser-Meyer-Olkin measure
PCA	Principal Component Analysis
RBV	Resource-Based View
SIC	Standard Industrial Classification
SMEs	Small and Medium Enterprises
VIF	Variance Inflation Factor
VRIN	Valuable, Rare, Inimitable and Non Substitutable

## Conference paper

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# CHAPTER 1: INTRODUCTION

## 1.1. Background of the Study

Innovation is a multifaceted phenomenon, the success of which is dictated not only by a firm's resources and its competencies, but is also greatly influenced by external macro-environmental factors. There has been intense technological development in the last few decades, which fuels innovation across all sectors by complementing as well as competing with each other. There is a strong realisation around the world that sustainable long-term economic growth can be achieved only when the majority of the firms, small or large, succeed with their innovative ideas and have consistency in their growth. This realisation has fuelled an unprecedented change in the UK government policies which, itself, is becoming more innovative to encourage and support innovation at various levels.

High-technnology small and medium enterprises (SMEs) have played a critical role in strengthening the world economy, and they continue to play an important role in invention, advancement of innovation and sustainable growth of the economy (Oakey and Mukhtar, 1999). According to Oxford Economics (2013) "SMEs around the world are leveraging technology to boost innovation, strengthen customer relationships, improve agility, and expand their businesses".

Innovative high-technology SMEs act as the initiator and catalyst for the technological changes in every sector and innovation increases the competitiveness of the firm (Roper, 1997). High-technology SMEs ability to act as an agent of change in the economy can be attributed to their adaptability and flexibility, their closeness to the market and suppliers, and their close-knit internal staff, and also, in some cases, entrepreneurs' willingness to take risk (Wynarczyk et al., 1993, Rothwell and Dodgson, 1994).

For British industry to compete in the world market, it is necessary to decrease the widening gap between productivity and innovation. In view of this, there has been an increasing interest in the development of dynamic firms with strong innovative potential, mainly high-tech electronics, ICT and biotechnology. This has resulted in the creation of many innovative clusters all over the UK (Romijn and Albu, 2002).

High-technology industries can be defined as “the firms with high dependence on science and technology innovation with above-average research and development (R&D) intensity and an above average proportion of scientists, engineers and technicians in the labour force, for the creation of new or improved products and services” (Butchart, 1987).

A firm’s ability to manage its innovation and successfully commercialise its invention is a key to its survival in the globally competitive business environment (Motohashi, 1998). A strategic plan will help the firm to have a consistency in the execution of an all-inclusive, broad plan to accomplish its goals in terms of performance. Innovation strategy plays an important role in determining the level and the way innovation is used to execute firms’ business strategy (Gilbert, 1994). The importance of the strategic role played by the innovation process and its competitive advantage at the firm level has been acknowledged by many scholars (Utterback, 1994, Tidd and Bessant, 2014, Oke et al., 2012b, Roper, 1977). Many organisations consider innovation as the main source of competitive advantage and studies developed on this perception have proposed models to develop innovation strategies that are consistent with market requirements, overall firm strategy, and the available technologies and resources of the firm (Scozzi et al., 2005, Utterback, 1994, Tushman and Moore, 1982).

High-technology SMEs which carry a high level of risk and compete in an environment that is more “dynamic, competitive and complex” require a well-structured innovation strategy, which is highly responsive to changes in the global market. There is an increase in the competition among high-technology sectors at an alarming rate, which is happening at the global level. This has created an interest in research studies to investigate the strategies of firms operating in the high-technology sectors (Jones and Crick, 2001). Most of the firms in high-technology sectors deal with one or the other kind of innovation from product innovation to innovation in service or trying to create an innovative business model. Innovation performance at the firm level is associated with many factors which are both external and internal to the firm’s environment (Keizer et al., 2002) and this needs a detailed investigation to understand the nature of their effect on firm’s business growth.

## 1.2. Statement of the Problem and Motivation for the Research

Today, SMEs in high-technology sectors are fuelling innovation, thereby churning the global economy by bringing new innovative products and services to the economy (Mason and Brown, 2013). The last decade has seen an unprecedented change in the technology sector, which is changing the way people think, live and behave in every aspect of their lives. There are sectors like biotechnology, healthcare, knowledge, and space technology which have been around for sometime, while there are some emerging high-technology sectors like 3-D printing, nanotechnology, digital media, green energy, mobile technology, and social media which are yet to unleash their potential in the economy. Most innovation is happening in small firms, indeed some of the small firms have become very large firms within a few years into their business by creating extraordinary value products and services.

While much has been written about innovation and its indicators, and innovation in SMEs, there is a dearth of academic research to study innovation strategy as an entity in itself. Even when there is an attempt to study innovation strategy exclusively, most of these studies are concerned with large firms. There is a huge gap in the study of innovation strategies in high-technology SMEs though it is an important factor in the success of innovation as well a firm. To begin with there are no established and widely accepted definitions of innovation strategy. The studies on the subject are carried out under various titles like technology strategy, R&D strategy, innovation strategy, and there are no clear distinctions established in these studies. In reality, these terms are significantly different and they are not mutually exclusive. Though there are a few studies which have established taxonomies and models of innovation strategy, they need further investigation.

The aim of this research is to recognise innovation strategy in a high-technology firm and to understand the nature of its influence on business growth of the firm. The next section outlines the aims, objectives and research questions of the study.

## 1.3. Aims, Objectives and Research Questions

There are studies on innovation strategies which have looked at the various aspects of innovation strategy and their influence on the performance of a firm (Oke et al., 2012b, Kuen-Hung et al., 2008, Börje and Hans, 2010). However, the research focus of this study

is on innovation strategy at the firm level which is responsible for the growth of the business. There are many theories which are associated with a firm's innovation and a firm's strategy like resource-based view (RBV) and dynamic capabilities (Abu Bakar and Ahmad, 2010, Tarafdar and Gordon, 2007, Terziovski, 2010a, Jeng and Pak, 2014, Grimaldi et al., 2013). The resource-based view is an important theoretical base as the theory focuses on the appropriate allocation of resources which play an important role in the formulation of a strategy for the success of an innovation. Likewise, the dynamic capabilities theory looks at the development of capabilities to have a competitive advantage by establishing practices that will help firms to develop capabilities continuously in order to respond to the ever-changing environment. Hence, this study will use the resource-based view and dynamic capabilities theory deductively to look at the role of innovation strategy in the business growth of high-technology SMEs.

#### 1.3.1. Aim

The main aim of this study is to: examine the innovation strategy used in high-technology SMEs and their role in the business growth of these firms.

#### 1.3.2. Research questions

The aim of the research can be achieved by identifying the factors which make a part of an innovation strategy for the success of an innovation and fuel the business growth of the firm. Moreover, as discussed earlier, the study needs to evaluate the resources and capabilities of high-technology SMEs since they are different from their large firm counterparts in every aspect: from the availability of resources, to how they react to changes in the environment. To address these issues and to achieve the aim of this research, the following research questions were raised:

1. How can we recognise innovation strategy within a high-technology small and medium business?
2. How does innovation strategy within a high-technology small and medium business relate to business growth?

### 1.3.3. Objectives

In order to find answers to the research questions and to achieve the aim of this study, a number of objectives have been developed. These objectives will enable the researcher to have clarity about the research direction and the way to achieve the aim of the research. The objectives of the study are:

- To explore the ongoing research, important theories and debates on innovation strategy and business growth of high-technology SMEs.
- To develop important indicators of innovation strategy and integrate them into a model that will have maximum influence on the business growth of a high-technology SME.
- To test the hypotheses, underpinned by existing theories, to understand the influence of innovation strategy on business growth in high-technology SMEs and in doing so to add to the existing body of knowledge.
- To present propositions for future research on innovation strategy in high-technology SMEs and inform practice.

The first research question will be answered with the help of first and second objectives. The third and fourth objectives will be of help in answering the second research question.

## 1.4. Context of this Study

There is an agreement among researchers about the role played by innovative high-technology small firms and its direct as well as indirect impact on the growth of not only the economy, but also for a better society in terms of health, environment, sustainable energy etc. In this context, it is very important high-technology small firms maximise the success of their innovation by adopting an appropriate innovation strategy based on a better understanding of the capabilities they need to develop by utilising the limited resources available to them. As stated by Hine and Ryan (1999), “innovation strategy required one to believe in the role of the internal environment in shaping the competitiveness of the firm”.

This research is an empirical analysis of the factors which form an important part of innovation strategy and its influence on business growth. The unit of analysis for this

research is high-technology SMEs in the UK. The phrase “high-technology” has captured the imagination of policy makers as well as investors alike for it has become the “economic holy grail” in both developed and developing countries in the twenty-first century (Markusen, 1996).

Today, it is not only large firms but also small firms that need to compete in a globalised market and they need to be able to respond to external factors to have successful innovation. The process of innovation is based on many factors; they vary on the basis of nature of the innovation and the sector in which they are being carried out, the size of the firm, the available resources, the nature of the economy they are based in and the government policies. It also depends on the firm size and its prior knowledge of innovation.

The innovation process is highly contingent and there is a wide gap between various disciplines. There is no one theory which assimilates firm-level innovation from various perspectives like economic, organisational, marketing, government policy, sociology, cognitive, psychological, managerial etc. The economic researcher looks at the economic incentives, whereas the psychologist will look at the factors influencing creativity. The organisational perspective is more concerned with the structure and the process involved, whereas the managerial perspective looks at the various factors that are responsible for increasing competitiveness (Pavitt, 2006).

However, in the last two decades there has been considerable research effort to have a clear distinction between various types of innovation and its sources (Garcia and Calantone, 2002, Tidd and Bessant, 2009b, von Hippel, 1988, von Hippel, 2005, Pavitt, 2006). Also, there is an acknowledgement of possible ways of managing innovation, though it is considered as a “random and uncertain phenomenon”. According to Tidd and Bessant (2014), innovation is a “sequence of planned experimentation” and one needs to recognise that it is not a random process.

Business and organisational strategy is one of the factors which influence innovation. This has been recognised by many research works on innovation management (Lopes et al., 2012, Goffin and Mitchell, 2005b, Tidd, 2001). Uncertainty associated with the innovation



can greatly influence various principles of the organisation and the decisions it takes on managing innovation and overall business strategy (Barbosa and Romero, 2013).

Miles and Snow (1978) proposed a strategic management typology which was based on three types of organisation: defenders, analysers and prospectors. These are considered as three ways in which organisations form their unique strategy and organisational structure, which will have a unique alignment of technology and process to respond to the any issues related to product development, administration and entrepreneurial characteristics which are the deciding factors of success of an innovation.

Firm-level innovation management is also greatly influenced by another area of study, project management. It is a common practice in organisations to manage the process of innovation based on the principles of project management while carrying out new product or service development. Based on this concept, there are two important models which are proposed in the innovation management field that have led to other variations of models in the field. One is the “stage gate model” (Cooper, 1990) and another is the “funnel model”(Wheelwright and Clark, 1992).

Another important framework in innovation management, which was influenced by funnel model, was proposed by Goffin and Mitchell (2005a), the Innovation Pentathlon Framework. This framework was designed on the basis of the assumption that it is the top management which is responsible for developing innovation strategy in order to achieve the goal of the innovation, and they need to focus on many factors in this process. The framework identifies five key factors which are crucial for innovation management: ideas, prioritisation, implementation, innovation strategy, and people and organisation. There were a number of areas with each factor which were discussed in detail. The first step in developing an innovation strategy is to have a clear assessment of the market trends to have a better understanding of the direction in which the company’s innovation needs to be targeted. It emphasises developing unique capabilities in R&D by appropriate use of resources, setting clear measures to assess the innovation performance, and having clear communication about the innovation process throughout the organisation (Goffin and Mitchell, 2010).

Another model of innovation management is based on technological innovation, open innovation, and innovation based on market factors (Dosi, 1982, Grönlund et al., 2010, Sawhney and Prandelli, 2000).

However, innovation management in high-technology SMEs lacks formally established process and it is more about adopting trial and error methods, especially where their process and service innovation is concerned (Teirlinck and Spithoven, 2013, Gassmann et al., 2010). An important factor in management of innovation is an appropriate allocation of resource and developing dynamic capabilities. Dynamic capabilities are about the “firms’ ability to “integrate, build and reconfigure internal and external competencies to respond quickly to the ever-changing environment” (Teece et al., 1997). In the context of high-technology SMEs, it is very important to incorporate the basic principles of the resource-based view and dynamic capabilities theory: technology firms increasingly have to compete; small firms have access to limited resources and also, in the case of high-technology firms, they have to develop strong dynamic capabilities as they face extreme pressures originating from rapid change in technology and market characteristics (Song et al., 2005, Teece and Pisano, 1994). Many researchers on innovation in SMEs have used the resource-based view and strategic management in SMEs with dynamic capabilities as the base for their studies (Henard and McFadyen, 2012a, Terziovski, 2010a, Sok and O’Cass, 2011, Burg et al., 2012, Terziovski, 2010b, Ghosh et al., 2001).

This study is an effort to look at innovation management in high-technology SMEs from both the resource-based view and the dynamic capability perspective and take a step forward in the research of innovation management in high-technology SMEs which requires more research studies to establish a framework which will incorporate both internal and external environments to compete in an internationalised market.

## 1.5. Significance of the Research

High-technology SMEs have become an integral part of the success of the economy and they are the experts of a unique technology that they create. However, it is very important they manage their innovation successfully with an appropriate innovation strategy to be successful in an internationally competitive market. However, there are limited research studies on innovation strategy in high-technology SMEs and this study addresses this gap.

This research study addresses innovation management from both internal and external environment perspectives, and develops a framework which will advance academic research and knowledge in this research area. The framework will also help the practice and practitioners as well as policy makers, in developing appropriate strategy for the business growth.

## 1.6. Research Boundaries

This research study is set under certain principles and thresholds as follows.

### 1.6.1. The larger context of the study

The theoretical foundation of this research study is based on the main broad areas of: Innovation, Innovation Strategy, High-technology SMEs and Business growth, Resource-based view and Dynamic capability.

### 1.6.2. Level of participants

The research is investigating a concept which is very sensitive in nature and every firm closely guards any information related to their innovation activity. This study requires data which can give a meaningful insight into the activities that are happening around the innovation to make it successful and this information can be available only with the top management of the company. Sometimes it is only the top management who will agree to share the information needed to carry out this research. Given the organisational structure of a high-technology SME it is more likely that a managing director, CEO or head of the product development who is also closely associated with the product development will have a more accurate and reasonable insight into the activities surrounding the innovation and the strategy that is adopted by the firm to carry out the innovation successfully.

### 1.6.3. The size of the firm

The sample for the empirical data required for this study is provided by the target population in high-technology SMEs. This study has adopted the SME definition of the European Commission, which is widely accepted in the UK in recent years by policy makers and academic researchers. SMEs are defined as firms with fewer than 250

employees and a financial turnover under €43 million (European Commission, 2009). The definition of SME is discussed in chapter 3 in more detail.

#### 1.6.4. Sector

A high-technology sector is target sample for this study. The study looks at both product and service innovation in SMEs in the high-technology sector. Based on previous studies and many current policies of government, as well as organisations promoting high-technology industries, Standard Industrial Classification (SIC) codes for the high-technology sector were shortlisted. The nature of participating firms is discussed in chapter 3 more in detail.

#### 1.6.5. Geographic limit

The sample is drawn from high-technology SMEs in the UK.

#### 1.6.6. Research methodology and process

The research adopted a quantitative method and used a survey questionnaire as a data collection tool to collect the primary data. Based on the theoretical framework, a questionnaire was developed and piloted to make any appropriate amendments, to collect the appropriate data from the targeted participants. The primary data was collected from the participants by sending the survey questionnaire through the mail and sending the online link through email to the top management of the high-technology SMEs..

### 1.7. Structure of the Thesis

There are six chapters which address each stage of the research process.

Chapter 1: This chapter gives an insight into the subject of the study and its background, the importance of carrying out the research to have a better understanding of innovation strategy and its structure, and its role in fuelling business growth. It also discusses the motivation of the research. The aim of the study is stated. Research questions and objectives are set in this chapter to achieve the aim of the study.

Chapter 2: This chapter carries out an in-depth review of the literature and critically evaluates the theoretical base of the arguments on innovation, innovation strategy and measures of innovation strategy. The chapter discusses various approaches taken by researchers to study innovation as well as various measures used to understand the nature of innovation and its influences on performance and business growth. The chapter introduces the definition of innovation strategy which makes the base for this study. It then critically reviews the existing taxonomies and frameworks which have tried to measure innovation strategy and also explores their influence on the success of an innovation, thereby propelling the performance and business growth of a high-technology SME.

The chapter also proposes the theoretical model to test the role of innovation strategy in the business growth of a high-technology SME. This is based on the concepts emergent from the literature review. Four hypotheses are proposed using the innovation strategy framework. The concluding part of the chapter discusses the methods used to measure independent and dependent variables.

Chapter 3: The discussion on the methodological aspects of this research study is presented in this chapter. It presents the research paradigm and methodological direction adopted by this research after a review of various research philosophies and methodological aspects. It also discusses in detail the data collection tool used and the process of data collection. It also presents the definition of high-technology SMEs adopted by this research.

Chapter 4: This chapter presents the analysis of the quantitative data collected for this study. The methods used for data screening and data cleaning in preparation for data analysis are presented. It then looks at the reliability and validity analysis. The chapter also presents the *t*-test data and other preliminary tests to carry out the model testing through multiple regression analysis. Hypotheses are tested and explained.

Chapter 5: The results of the data analysis are discussed in this chapter. The findings are critically evaluated by linking them with previous studies.

Chapter 6: The research findings are summarised in this chapter. It also discusses answers to the research questions and revisits the objectives of the research. It further discusses the significance of the research as well as the contribution made to knowledge development

and its practical implications. Limitations of this study and recommendations for future research as well as practice are presented.

Appendices: The appendices include SIC codes used in this study, Cover letter sent with postal mail survey questionnaire, final version of the questionnaire, reminder letter to follow up on the participation and an email copy with link to online questionnaire.

## CHAPTER 2: LITERATURE REVIEW

### 2.1. Introduction

This chapter aims to critically review the existing literature on the research topic and present a theoretical underpinning to achieve the aim and objectives of this study. It also discusses the theoretical base of the core concepts of the research: innovation strategy and its influence on business growth. The chapter introduces the concepts of innovation, innovation strategy and business growth and the relationships among these concepts. The chapter critically evaluates the evolution of the literature on innovation strategy, its importance in the growth of high-technology SMEs in particular and also the literature which makes the base for this research. Overall, this chapter establishes the foundation for the theoretical framework and the empirical study, addressing research objectives 1, 2 and 3.

### 2.2. Background

As defined by Tidd and Bessant (2014), innovation is “the process of creating value from ideas”. Hence, the change is not for the sake of it, but to create a value proposition. Innovation is a multifaceted concept which has been studied from various perspectives over the last few decades. The word innovation has its origin in Latin “innovare” and is about reform and change. Economists like Baumol and Blinder (2012) have attributed economic growth since the eighteenth century to innovation and today, almost all governments globally are trying to create an environment in their respective countries which can stimulate innovation at various levels.

Innovation is considered as a “key contributor to the competitive advantage and survival of firms” (Tidd et al., 2005 , Oke et al., 2012b, Tidd and Bessant, 2009a). However, the rapid technological change that we are witnessing in this decade has made the targeted end results of innovation’s aim, change constantly. This has prompted innovation practitioners to take a keen interest in the strategic management of innovation. Strategic management is not only about managing business for today, but a long-term management of affairs to have a competitive advantage over one’s competitors. This can be achieved by utilising the resources at disposal at the optimum level to create dynamic capability to have an edge over competitors all the time (Tidd and Bessant, 2014).

Innovation strategy as an academic discipline is in its early stages. The discussion of innovation strategy has been predominantly based on a synergetic result of scholarly research on innovation and strategy (Stankevice and Jucevicius, 2012, Ahmed and Shepherd, 2010, Davenport et al., Oke et al., 2012a, Zahra, 1996). This has led to a variety of approaches to the term innovation strategy, as scholarly research on innovation and strategy has seen a proliferation in various directions. However, in recent years there is an effort to study “innovation strategy” as a separate entity and develop various models to understand its constituents and its interaction with business performance and business growth.

The research on innovation strategy has mainly concentrated on large firms and there are very few studies making innovation strategy in SMEs a focal point (Le Roy and Yami, 2007, Juan and Julong, 2012, Branzei and Vertinsky, 2006). It is very important to have dedicated research into innovation strategy directed towards SMEs as it is established fact that SMEs behave and interact with the external environment differently than larger firms. They also have an acute resource constraint compared to larger firms. Many studies have investigated the number of key factors which determine innovativeness of an SME and have looked into their influence on the performance of innovation as well as the firm's business (Hult et al., 2004).

Firm-level strategy contributes to the success of an innovative SME (Le Roy and Yami, 2007). However, the success of its innovation depends on gaining competitive advantage by “carefully planning and executing strategy” to carry out R&D, manufacturing, marketing, distribution etc (Hall and Bagchi-Sen, 2007). A study carried out by Keizer et al. (2002) presented a taxonomy for innovation strategy, which summarised the key variables which can positively influence the “innovative efforts of SMEs”. They were classified as external variables, those which can create opportunities for an SME from the outside environment and internal variables, those which are “characteristics and policies of a SME”. Collaboration with other firms, Linkages with knowledge centres and Utilising financial resources or support regulations are identified as external variables. Strategy, Structure, Technology policy, Level of education and Investments in R&D are identified as internal variables. The interesting point to note here is, in this study innovation strategy is measured by “Explicit strategies to increase and stimulate internal creativity and risk taking behaviour”, “Strategies implement state-of-the-art production technology and



automation” along with strategic management practices (Birchall et al., 1996, Carrier, 1994). Success of an innovation is a very complex phenomenon and depends on both internal factors and external factors, as well as hard factors related to products and soft factors related to management. Thus, there is a need for more systematic research on innovation strategy to establish a framework which involves innovation strategy variables. The following sections review the concepts of innovation, innovation strategy, business growth and the determining factors of these concepts.

### 2.3. Innovation and Evaluations of Various Theories

Innovation has been the main focus of many firms and governments for years. It plays an important part in shaping the growth and competitiveness of firms, industries and regions (Stankevicius and Jucevicius, 2012). Literature on the topic dates back to the 1960s and, on an economic level, to the beginning of the twentieth century (Schumpeter, 1912 / 1934). From the strategic point of view, innovation can be considered as an important factor to increase competitive strength (Tidd et al., 2005 ). Hence, innovation is seen as a factor to generate new income and profits which can fuel the business growth of the firm (Trott, 1998).

Invention is an emergence of an idea for the first time whereas; innovation is an attempt to convert the idea into practice for the first time (Fagerberg, 2005). A wide range of research on innovation was conducted in the twentieth century and it has seen a phenomenal rise in the last decade. There is an acceptance in the research community that innovation is not just a random occurrence and there is a “method to madness” and this can be studied systematically (Nagaraju and Philpott, 2011). It has been widely accepted that Schumpeter is the pioneer in introducing the study of innovation. He advocated innovation as a source of economic change and technological innovation as a source of business cycles. Schumpeter was the first to make a clear distinction between invention and innovation. In his view, innovation is an economic decision of a firm whereas invention is an intellectual creativity which has no importance to economic analysis unless it is adopted successfully by the firm (Schumpeter and Swedberg, 1994, Godin, 2008).

However, it is MacLaurin (1950), an economic historian, who further developed Schumpeter’s ideas and gave a systematic structure for the study of technological

innovation for the first time. He tried to establish a structure through which the process of technological advance could be broken down into elements that may eventually be more measurable. He proposed a theory of technological innovation, which later came to be known as the linear model of innovation. He was the first to construct taxonomies for measuring technological innovation (Godin, 2008).

Literature on innovation has also seen the immense contribution by Von Hippel, Tidd, Bessant and Fagerberg in the last few decades, who have contributed to knowledge of innovation measurement, management of innovation, innovation policy and various sources of innovation (Nagaraju and Philpott, 2011). The initial literature review revealed that the concept of innovation includes novelty, commercialisation and implementation of an idea (Popadiuka and Choo, 2006). According to Urabe et al. (1988), “Innovation consists of the generation of a new idea and its implementation into a new product, process or service, leading to the dynamic growth of the national economy and the increase of employment as well as to creation of pure profit for the innovative business enterprise.” There is an agreement among researchers that innovation comes in different forms (Gopalakrishnan and Damanpour, 1992, Utterback, 1994, Cooper, 1998). Innovation is studied with different dimensions – Radical versus incremental innovation, Technological versus administrative innovation and Product versus process innovation, to name a few (Cooper, 1998).

### 2.3.1. Definition of Innovation

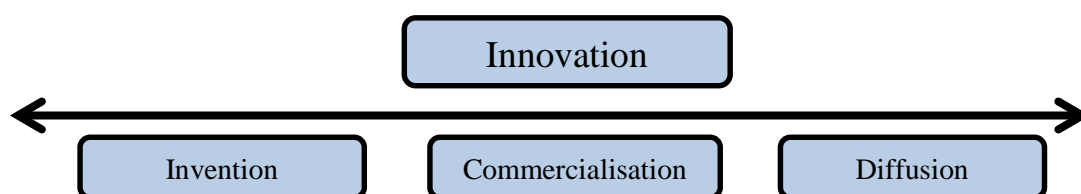
As the concept of innovation has been studied as an abstract concept of a systematic process, and also from various perspectives, there is no one definition which has been universally accepted. Innovation as a concept has been a part of many disciplines and each definition aligns with the leading paradigm of that particular discipline (Baregheh et al., 2009).

A systematic study to analyse the various definitions across disciplines was carried out by Baregheh et al. (2009) which identified 60 definitions in total across seven disciplines: Business and management, Economics, Organisation studies, Innovation and entrepreneurship, Technology, Science and engineering, Knowledge management and Marketing. There are many studies which have raised the question of lack of clarity in

defining the term innovation and its implications for practice as well as academic research. These studies have called for a universally accepted definition of innovation, which can help to create a better understanding among various practitioners within the organisation. This can also facilitate researchers across the discipline to collaborate and investigate this complex concept more holistically. (Baregheh et al., 2009, Kahn et al., 2003, Danneels and Kleinschmidt, 2001)

In the absence of a universally accepted definition, it is important to have a definition which addresses some of the attributes of innovation, such as the nature of innovation, type of innovation, aim of innovation and its social context, means of innovation and various stages of innovation.

The nature of innovation is concerned with whether the innovation is new or an improvement over a previous innovation, whereas type of innovation is concerned with whether the innovation is with reference to product, process, service or organisational innovation. It is also important to understand the social context, i.e., whether the innovation is concerned with organisation, firm, industry, customer, employee, external environment, etc. Idea, invention, technology, market and creativity are associated with means of innovation, whereas adoption, development, creation, implementation and commercialisation are associated with stages of innovation (Baregheh et al., 2009). Therefore, a line can be drawn between invention and innovation, which includes many stages or processes that encompass various activities, such as R&D, employee training, patenting, financing, marketing etc. The first stage in any innovation is invention, and then commercialisation, and the last stage is diffusion (Smith, 2010). Different resources and capabilities are required at each stage that can help knowledge transformation and successful realisation of final new product and services.



**Figure 2.1: Stages of Innovation (Smith, 2010)**

This study is about a firm-level innovation and its aims is to understand its success and influence on business growth. The most appropriate definition was found in the Oslo Manual, a joint publication by the Organisation for Economic Cooperation and Development (OECD) and Eurostat, which covers the broad range of areas where the innovations are possible. According OECD/Eurostat (2005),

“an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations”.

Here, the main four areas of innovation are considered: product, process, marketing and organisational innovation. Detailed definitions were given for each of these innovations. (See appendix C). Though marketing factors were traditionally not considered as one of the main areas of innovation at the firm level, the importance of marketing is increasingly finding its way into the study of innovation and this has been recognised by Oslo Manual (2005). The definition also addresses the three important questions related to innovation, i.e., where the changes are happening (business practice, workplace organisation or external relations), to what extent (new or significantly improved) and its sources (product, process, marketing or organisation method). This definition covers the various important aspects of innovation and it helps this study in terms of looking into strategic aspects of innovation leading into commercial success (Battisti and Stoneman, 2010).

### 2.3.2. Theoretical background

Resource-based view of the firm and dynamic capabilities theory are extensively used in the study of innovation management (Kostopoulos et al., 2002, Vicente et al., 2015, Song and Parry, 1997, Damanpur, 1991). The fundamental premise of the resource-based research on innovation is: a firm's capacity for innovation is determined by its resources and capabilities. There are number of critical resources both tangible and intangible which are an important inputs in producing an innovative output using existing capabilities which can then be turned into a competitive advantage for the firm.

Resource-based view has been used in many management study and there has been also critical evaluation and scrutiny of its contribution to firm development (Kraaijenbrink et al., 2010, Abrantes et al., 2015). Resource-based view was developed to complement the industrial organisation view which focused on the structure-conduct-performance paradigm. The determinants of firm performance in industrial organisations were mainly drawn from the structure of the industry which was external to the firm. However, resource-based view tried to explore the internal sources of sustained competitive advantage of a firm and explain the possible reasons for the difference in performance of the firms from the same industry (Kostopoulos et al., 2002).

Another important theory which has made a contribution to the study of strategy is dynamic capability theory. In order to survive in the ever-changing market, firms should possess the ability to make sense of changing business environments and organise, recombine and reorganise resources and make changes to their business models. To achieve this they need to have dynamic capabilities (Teece, 1994), which is defined as “the ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environment” (Naldi et al., 2014). The important part of developing dynamic capabilities is “sensing and seizing” opportunities, which will have a positive effect on the innovative performance of the firm. However, firms can achieve a positive effect only when the capabilities they possess surpass the threshold level of the industry standards. There is an increase in attention towards dynamic capability theory in the management literature which has resulted in the long-standing importance given to the link between the strategic choices of the firm and its environmental conditions in the literature of strategy and organisation theory (Kim et al., 2015, Naldi et al., 2014, Teece et al., 1997, Thompson, 1967). Dynamic capabilities approach was proposed as an extension to Barney’s resource-based view of the firm. Teece et al. (1997) proposed a framework to fill the gap in RBV’s argument on firm performance as RBV was considered by its critics as static in nature and not adequate to explain how a firm can achieve competitive advantage in a changing environment. Though Teece and Pisano (1994) tried to introduce the concept of dynamic capabilities in 1994, it was their article in 1997 which attracted remarkable attention from management scholars to the new concept (Barreto, 2010).

There are multiple definitions of resource-based view and dynamic capabilities of the firm which are listed Table 2.1.

**Table 2.1: Definitions of resource- based view and dynamic capabilities of the firm****(a) Resource-based view**

<b>Author</b>	<b>Definition</b>
Penrose (1959)	Firm is a collection of resources and the heterogeneity of the output available from resources gives each firm its unique character.
Daft (1983)	Firm resources include all assets, capabilities, organisational progress, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness.
Rumelt (1984)	Firms are a bundle of resources and its economic value vary depending on the resources it has.
Barney (1991)	Rare and Valuable resources and capabilities helps the firm to attain competitive advantage. And if these resources are inimitable and not substitutable, it leads to a sustained competitive advantage.
Powell (1992)	Resource based view holds that, in order to generate sustainable competitive advantage, a resource must provide economic value and must be presently scarce, difficult to imitate, nonsubstitutable, and not readily obtainable in factor markets.
Amit and Paul (1993)	A firm's resources are a source of competitive advantage to the degree that they are scarce, specialised and appropriable
Barney (2001)	A firm that possesses a particular valuable resource that is rare and obtained in unique historical circumstances can gain a sustained competitive advantage.

**(b) Dynamic capabilities Theory**

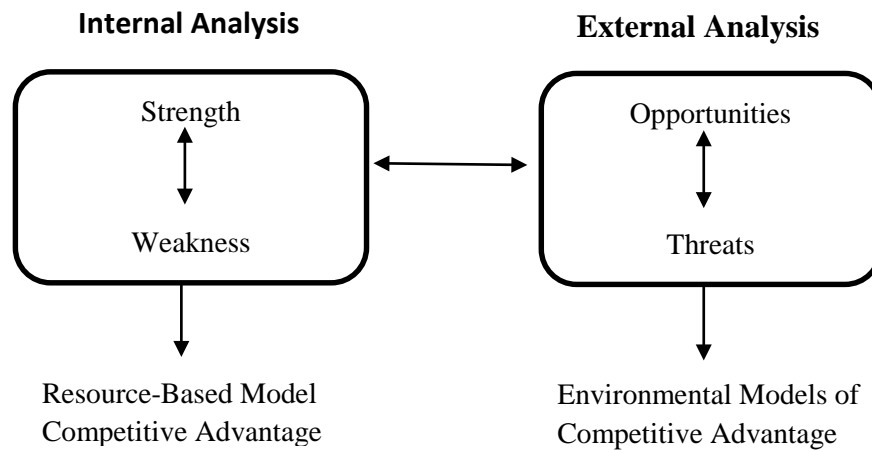
<b>Author</b>	<b>Definition</b>
Teece and Pisano (1994)	Dynamic capabilities are the firm's ability to integrate, build, and reconfigure its internal and external competences which can create firm's unique product and process to address rapidly changing market environments.
Zollo and Winter (2002)	Dynamic capability is a learned and stable pattern of collective activity, through which organisations systematically generate and modify their operating routines to enhance their effectiveness.
Helfat and Peteraf (2003)	Dynamic capabilities help the firm to adapt and change by building, integrating and reconfiguring resources and capabilities. Capabilities include all organisational capabilities.
Zott (2003)	Dynamic capabilities are embedded in organisational process and are captured by routines of the firm that are aimed at responding to the changes in the business environment by retaining firm's resources, capabilities and operational routines.
Eriksson (2013)	Dynamic capabilities are the capacity of the organisation to purposefully create, extend, or modify its resource and capability bases to address changes in its environment.

This study derives its theoretical base from the RBV and dynamic capability theory as they provide a framework to evaluate the various factors which contribute to the better performance which contribute to the positive business growth. RBV has developed its thought process based on the assumption that a firm can have a competitive advantage not just by owning exclusive resources, but also by having an ability to exploit and renew them in such a way which is superior to its competitors (Barney, 2001, 1991). However, the advocates of the dynamic capability theory are of the opinion that it is not just the resources and appropriate exploitation of the resources, but also the ability of a firm to respond to environmental changes (both internal and external), by swiftly developing appropriate capabilities, which gives a firm competitive advantage (Ellonen et al., 2011, Teece and Pisano, 1994). Firms should develop “dynamic capabilities” by utilising the available resources appropriately, to have a competitive advantage over their competitors in terms of market development and market penetration (Johnson et al., 2010). Dynamic capabilities theory’s main emphasis is on two key principles of strategic management: a constant change in the characteristics of the environment (both internal and external) and emphasis on appropriate adaptation, integration and rearranging of resources, competencies and the skills to the constantly changing environment (Teece, 2012).

### 2.3.3. Theoretical models of RBV and Dynamic capability

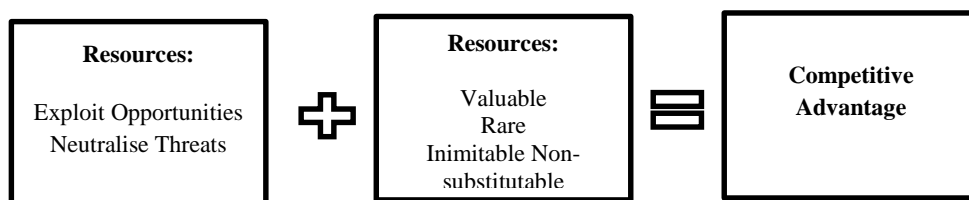
The management research has proposed many models and frameworks based on RBV and Dynamic capability to explore various factors that contribute to better performance of the firm (Barney et al., 1993, Teece, 1994). The models in the strategic management literature has tried to explore the various internal and external as well as tangible and intangible factors. Barney (1991) who tried to explore the sources of sustained competitive advantage and the link between resources of the firm and its competitive advantage, emphasised the importance of both internal analysis and external analysis (see Figure 2.2). When strategic management literature started focusing on external analysis by emphasising on opportunities and threats in the competitive environment, they gave very little attention to the impact of distinctive nature of firm on its competitive position. (Caves and Porter, 1977, Porter, 1980). The theories based on environmental models of competitive advantage assumed, all the firms who are in the same industry or same strategic group will be identical in terms of the strategy they pursue and the resources they control which are strategically very important. The resource-based models took a different

view on this assumption and proposed alternative assumption in exploring the sources of competitive advantage of the firm. The alternative assumption of resource-based model was, firms with in the same industry or same strategic group may have heterogeneous strategic goals and may control heterogeneous strategic resources.



**Figure 2.2: The relationship between traditional “strength-weaknesses-opportunity-threat” analysis (Barney, 1991)**

Strategy formulation based on resources follows an ‘inside-out’ process, which differs from the strategy formation percetive of industry economics. RBV is of the opinon, the strategy based on the firm’s core resources will be better than the continuously trying to adjust the firm operating sets to match with the environmental changes. The firm with ample resources can survive and grow due to their strong competitive advantage irrespective of the changes in the external environment. Firms that might not have adequate resources to succeed can gain required resouces and capabilities through strategic alliances that can complement the resources of each other (Wu, 2005). Figure 2.3 demonstrate the how competitive advantage is gained by the firm from their resources.



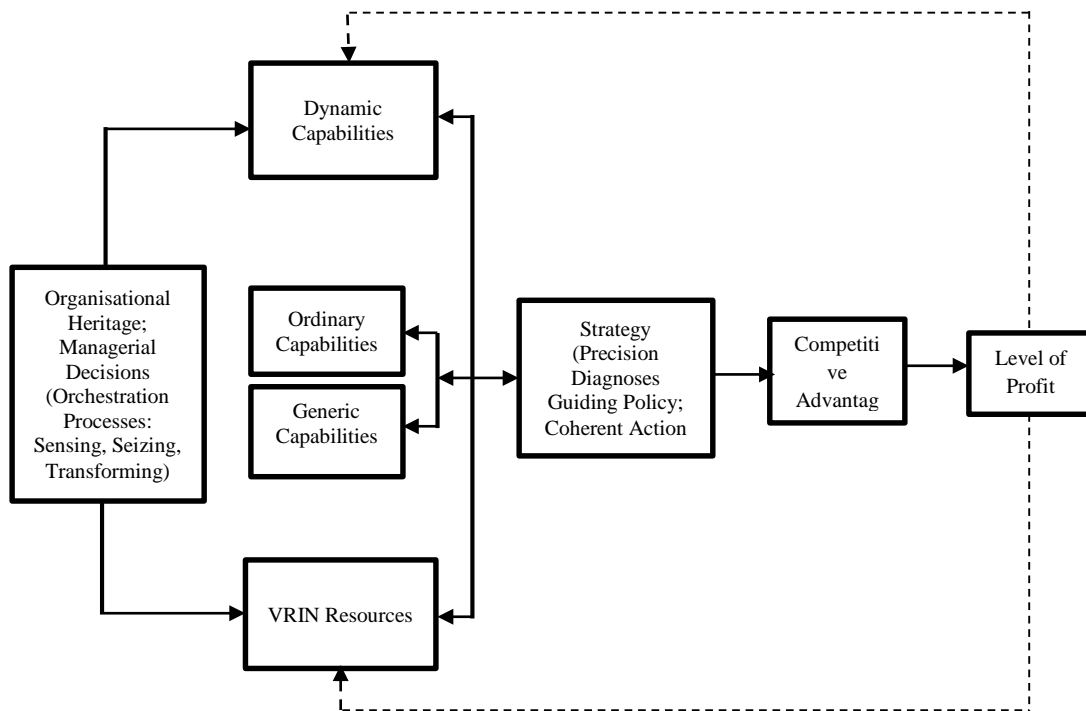
**Figure 2.3: Resource-Based View**  
Source: Barney (1991)



Dynamic capabilities are the forebearer of strategic routines through which the managers can transform their available resources to create new strategies which will have unique value. They also can nurture creation through the evolution and recombination of the exisiting resources into their competitive advantage (Wu, 2005). Iansiti and Clarck(1995) research on integration capability showed a positive relationship between knowledge integration capability and firm performance. This confirm with the dynamic capability theory which proposes dynamic capability can propel the firm's performance.

Dynamic capabilities are vital for recognising competitive advantage in a volatile environment (Zollo and Winter, 2002). This suggestion is antecedent to the knowledge that, irrespective of environmental unpredictability, dynamic capabilities can help to acquire the competitive advantages through an integrative approach. Hence, volatility of the business environment does not moderate the liaison between dynamic capability and competitive advantage (Wu, 2010).

Dynamic capabilities do not work in isolation. An effective strategy coupled with dynamic capability can create competitive advantage. Teece (2014) presented a capability framework with a clear logic presented in Figure 2.4. The framework identifies organisational capability as the key driver of enterprise performance. They are supported by VRIN resources. It proposes that for long-term success of the firm, presence of dynamic capabilities, VRIN resources and a clear strategy is necessary.



**Figure 2.4: The Logical Structure of the Dynamic Capabilities Framework**

Source: Teece (2014)

Teece (2014) identifies two kinds of capabilities: ordinary and dynamic. Operations, governance and administration are considered as ordinary capabilities whereas innovation, R&D, enterprise-level entrepreneurship, marketing, learning and development are considered as dynamic capability.

Though RBV and Dynamic Capability theory have been the central theoretical base of strategic management literature, there are some criticisms of both the theories. There are some strong criticisms of RBV's various aspects. There are some direct critiques of the RBV (Foss and Knudsen, 2003, Priem and Butler, 2001) and there are some criticisms which are levelled indirectly by calling for amendments to RBV (Makadok, 2001, Foss and Knudsen, 2003). Joroen et al. (2010) carried out a detailed assessment of the critique of RBV and categorised some of the main critiques of RBV. Prime and Butler (2001) questioned RBV's managerial implication whereas Makadok (2001) is of the opinion, Value, rarity, inimitability and non-substitutability of resources is neither necessary nor adequate to achieve sustainable competitive advantage.

Responding to the Lado et al.'s (2006) argument that there is a clash between descriptive and prescriptive theorising, Van de Ven (2007) is of the opinion that this tension can be seen through out the management research and there is no solution found to this issue.

Hence, it would be unfair to criticise RBV's managerial implications, without taking into account the limitations of management research.

The relationship between VRIN and sustainable competitive advantage is subjected to criticism by many scholars (Prime and Butler 2001, Armstrong and Shimizu, 2007, Foss and Knudsen, 2003, Makadok, 2001). There are some fundamental differences about the nature of markets, resources, attributes of entrepreneurs, managers and individuals and their role in generating sustained competitive advantage. It is pointed out that sources for sustained competitive advantage can also arise from productive opportunities, integrative capabilities, and interdependencies (Teece, 2007). There can be no resources which can be valuable for all the firms and it might need firm-specific adjustments. To achieve sustained competitive advantage, a firm requires not just a bundle of resources but also managerial capabilities to identify the productive opportunities available in these resources and exploit them. This is one of criticism RBV fails to respond adequately.

There are also criticisms of the Dynamic Capability framework by some scholars (Williamson, 1999, Arend and Bromiley, 2002, Eisenhardt and Martin, 2000, Winter, 2003, Zahra et al., 2006). Dynamic capability is labelled as tautological with circular definitions and believed dynamics of the strategic change are oversimplified. Teece (2014) countered these criticisms by producing a detailed framework of dynamic capability. He is of the opinion, sustainable performance and growth of the firm required dynamic capability. However, if these dynamic capabilities are aligned with a poor and misjudged strategy, then they become irrelevant. There are empirical studies by Danneels (2001) and Tripasas and Gavetti (2000) which have supported the dynamic capability framework. These studies have highlighted the dynamic capabilities critical value in supporting firms in making profit repeatedly through identifying demands and mobilizing resources to satisfying them.

The above evaluation of the RBV and Dynamic capability theory does indicated, a firm can achieve the profitability and growth through their resources and capabilities. Through RBV in a very important theory at the firm level, its weaknesses is in ignoring the importance of managerial capabilities in achieve sustained competitive advantage. To over come this weaknesses, the best way forward is to include dynamic capabilities which adequately explain how a firm can develop and integrate its resources in a rapidly changing environment.

#### 2.3.4. Dimensions of innovation

Innovation has many dimensions and has been modelled from various perspectives. (Gopalakrishnan and Damanpour, 1992). The relevance of the issue of dimensionality arises from the interaction among different organisational characteristics and numerous types of innovation. The adoption of a particular type of innovation is determined by various characteristics of an organisation, such as size, organisational structure, resources etc. (Cooper, 1998).

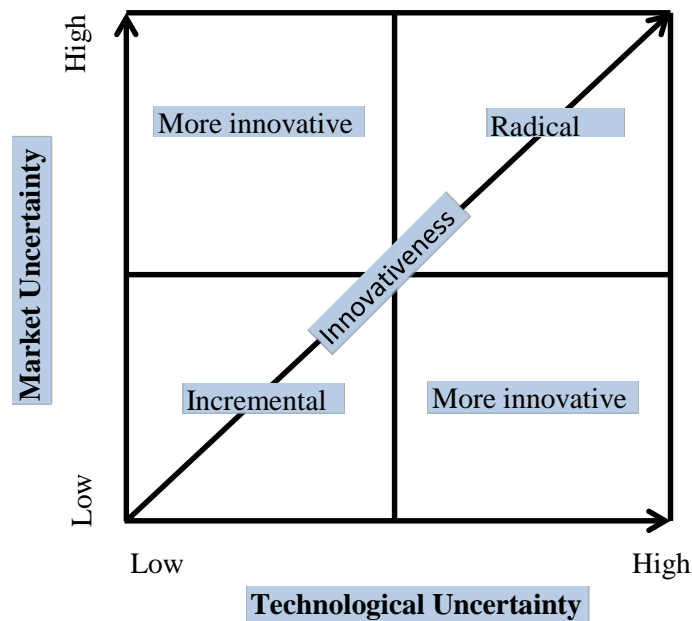
The relationship between organisational structure and type of innovation are discussed on the basis of various factors. However, two main factors are related to the strategy and the power of the firm. Chandler (1962) argued that an organisation that strives to survive and have a competitive advantage and success should align its organisational structure with an appropriate innovative process that can facilitate the firm's strategy. Porter (1980)'s generic strategy identified process innovation as a key factor for cutting costs and achieving a low-cost strategy, whereas a firm's structure and ability, which can facilitate the generation of new ideas for producing new products or improving an existing product with new features, can achieve a differentiation strategy.

Another reason for the type of innovation associated with organisational structure is related to the power existing within the organisation. Daft (1978) in his dual core model of -innovation argued that technological innovation thrives in an organisation which has an organic structure, whereas a bureaucratic structure stimulates administrative innovation.

#### 2.3.5. Radical vs. Incremental Innovation

Important discussions of innovations are based on the concept of radical versus incremental innovation and product versus process innovation. Holan and Patricia's (2013) model discussed radical and incremental innovation based on the uncertainty matrix which was proposed by Ansoff (1988). The model used technological uncertainty and market uncertainty as a base to discuss Innovativeness. Radical innovations, which are described as new to the world, are seen as destroyers of existing products and also require revolutionary alterations in the organisational structure. Radical innovations entail a high level of uncertainty and a risky departure from present practices. In contrast to radical innovation, incremental innovations entail a lower level of uncertainty and follow the

existing technical order. They are not totally new to the market as they try to enhance the existing product by extending the underlying technology (Tushman and Anderson, 1986).



**Figure 2.5: Radical and incremental innovation model (Holan and Patricia, 2013)**

The above model discusses incremental and radical innovation from technological and marketing uncertainty perspectives. Technology enables the innovation which can be radical or incremental, and it is recognised as the main source of the competitive advantage (Morone, 1993, Garcia and Calantone, 2002, Hill and Roethmel, 2003). Innovations play an important role in transforming existing markets or in creating a new market. Radical innovations face a high degree of uncertainty since to achieve commercial success, they have to respond to an emergent customer market or create new technology competencies. This requires innovative knowledge and learning of new skills, practices and building new relationships and capabilities. This situation can create not just technical and market uncertainties, but also there can be resource and organisational uncertainties (Levinthal and March, 1993, Christensen, 1997, Hill and Rothaermael, 2003, Freeman and Soete, 1997, O'Connor, 2008). Here, resources as well as developing dynamic capabilities are very important for success of the innovations.

### 2.3.6. Marketing and Technological capabilities

Another innovation model proposed in Abernathy and Clark (1985) was based on marketing and technological capabilities of a firm. This model has a matrix of four types of innovation, which was determined by preservation or distortion of technological capability and marketing capability. The four types of innovations are: (a) Regular Innovation, which is based on both technological capabilities and knowledge of the market; (b) Niche Innovation, which is the result of technological capabilities even when market knowledge is obsolete; (c) Revolutionary Innovation, which has the capacity to make the technological capabilities obsolete, however, market knowledge is preserved; and (d) Architectural Innovation, which makes both market capabilities and technological capabilities obsolete. This model is represented in Table 2.2.

**Table 2.2: Abernathy and Clark's Model**

Market knowledge	Technical capabilities	
	Preserved	Destroyed
Preserved	Regular Innovation	Revolutionary Innovation
Destroyed	Niche Innovation	Architectural Innovation

Source: Albeshier (2014a)

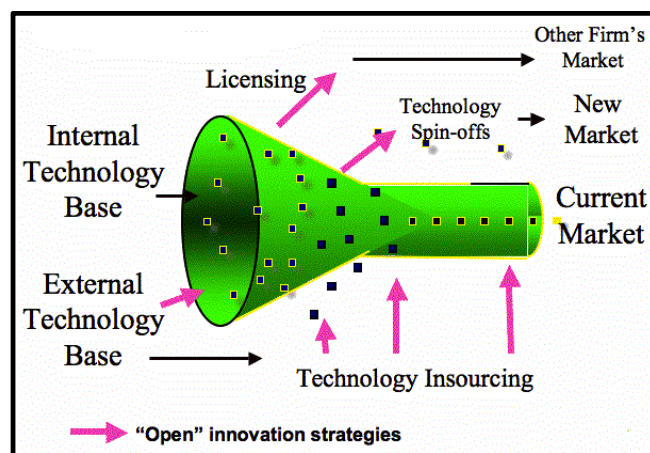
Industry boundaries are shifting or getting blurred due to converging technologies and are changing the course of product and services (Prahalad and Ramaswamy, 2003). Also, it is the changes in the market which are no longer just incremental and are creating an opportunity for innovation (Ducker, 1998). To achieve sustainable competitive advantage, it is vital for the firm to have technical capabilities and market knowledge which helps them to distribute their existing resources wisely and develop dynamic capabilities. Market knowledge and technical capabilities themselves act as dynamic capabilities for an innovative firm and they will determine the type of innovation they can achieve.

The four clusters indicate various levels of innovation and indicated different level of skills and knowledge. Firms may be able to achieve competitive advantage by using these knowledge and skills to develop other strategies which could be more effective. Abernathy and Clark's (1985) model explains the relationship between market knowledge and technological capabilities and the possibilities of type of innovation. The model can help

managers in decision-making about the future direction of their firm based on their core competencies. This decision can be taken from the perspective of market forces and the information they have about the changing market. This can be a valuable resource for the firm and they can combine it with the technological capabilities they have to achieve a certain innovation pattern.

### 2.3.7. Open Technological Innovation

Innovation at firm level could be a result of R&D activities, or it could be a result of external interaction and acquired from an external source, such as collaborating with a supplier or a customer. The innovation could also be acquired through licensing or patent access (Tidd and Bessant, 2011). Though R&D can be a closed model of innovation, to have sustained competitiveness, it is important to have interaction with external stakeholder to gain new ideas and resources. Chesbrough (2003) used the term “open innovation” to describe the open model of innovation (see Figure 2.6). Open innovation calls for firms to use both external and internal ideas as well as internal path and external path to market while trying to advance their technology.



**Figure 2.6: Open technological innovation paradigm**

Source: Chesbrough (2006)

Open strategy follows the belief of traditional businesses along with the assurance of open innovation embedded within the strategy. It aims to expand the value creation for its firm by adopting openness (Chesbrough & Appleyard, 2007). There is a paradigm shift in the way commercialisation of the knowledge is happening in the high-technology industry. There is an increase in the diffusion of useful knowledge and there is an exchange of knowledge among firms, customers, suppliers, innovative labs, Universities etc. Lakhani, K. R., & Von Hippel, E. (2003). In an open innovation environment the firm uses both

internal as well as external ideas, resources and capabilities (Chesbrough 2003). Open innovation research and dynamic capabilities are interlinked as they both emphasises on the achieving a superior performance by aligning with both internal and external sources. To achieve superior performance and growth, the firms need to be innovative in all aspects from their business models to technological and marketing strategy. As there is an increasing pressure on firms to adopt open technological innovations where they also benefit, they also need to develop new capabilities realise the open strategies in a productive way. Hence they also need to develop dynamic capabilities which can enable them to adapt to the changes in the environment that can lead to a better performance of the firm. Hence dynamic capabilities can act as a catalyst in enabling the firm to achieve superior performance through all the available resources both internal and external (Amit and Paul,1993)

Table 2.3 summarises the link between the above-discussed models and the theoretical base of this research study.



**Table 2.3: Innovation models and its relation to the RBV and Dynamic Capability theory**

<b>Innovation Models</b>	<b>Key Factors</b>	<b>Link to RBV and Dynamic Capability Theories</b>
Radical and incremental innovation model (Holan and Patricia, 2013)	<ul style="list-style-type: none"> <li>• Technological Uncertainty</li> <li>• Marketing Uncertainty</li> <li>• Radical Innovation</li> <li>• Incremental Innovation</li> <li>• Innovativeness</li> </ul>	<p>To achieve innovativeness through radical innovation the firm has to deal with high level of uncertainty of technology and market.</p> <p>Developing new source of knowledge and dynamic capabilities can help the firm achieve negate these uncertainties by achieving sustainable competitive advantage.</p>
Marketing and Technological capabilities  Abernathy and Clark's Model (1985)	<ul style="list-style-type: none"> <li>• Market Knowledge</li> <li>• Technical Capabilities</li> <li>• Regular Innovation</li> <li>• Revolutionary Innovation</li> <li>• Architectural Innovation</li> <li>• Niche Innovation</li> </ul>	<p>The emphasis is on market knowledge which can be a great source of competitive advantage (RBV) and technical capabilities which can be a dynamic capability of the firm (Dynamic Capability).</p> <p>These two factors determine the pattern of innovation a firm will be able to achieve.</p>
Open Technological Innovation (Chesbrough, 2006)	<ul style="list-style-type: none"> <li>• Internal Technology Base</li> <li>• External Technology base</li> <li>• Licensing</li> <li>• Technology Spin-offs</li> <li>• Technology Insourcing</li> <li>• Other Firm's Market</li> <li>• New Market</li> <li>• Current Market</li> <li>• Open Innovation Strategies</li> </ul>	<p>The emphasis is achieving sustainable competitive advantage using both internal and external factors.</p> <p>Internal Technology Base, Licensing, External Technology, Technology Spin-off and Technology Insourcing can be resources with VRIN characteristics (RBV).</p> <p>Developing new dynamic capabilities of the firm can help to deal with the Other Firm's Market and New Market. This can also be great help in realising open innovation strategies.</p> <p>Interaction between internal and external factors can help the firm to achieve sustainable competitive advantage.</p>

### 2.3.8. Innovation measurements

Innovation is about unique ideas and processes, which when introduced in the firm will increase the overall performance of the organisation. However, no one indicator can help to measure the impact of innovation activity as innovation covers activities at various levels and wider range. Also, the activities differ from one firm to another (Rogers, 1998).

Innovation has many dimensions and all these dimensions need to be taken into consideration for its success. Product innovation is an important aspect for a manufacturing or a product-based firm. However, they can also create a sustainable competitive advantage for the product through service innovation which can differentiate a product from their competitors. Another dimension could be business process innovation which can optimise the various organisation processes that can cut cost. Innovation also goes through many phases from generation of many ideas to choosing the best concept and implementation.

The innovation literature has proposed many indicators or measurements which have been developed from many perspectives. A key approach adopted by researchers was to have input- and output-based indicators to measure innovation (Rogers, 1998, Smith K., 2006); they also used econometric techniques. Output measures looked at the outcome of the innovation, like the introduction of new or improved product or process, the percentage of sales of new/ improved product or process, intellectual property statistics and firm performance measured by profit, revenue growth and market share and growth. Some of the input measures were related to R&D, intellectual property statistics, acquisition of technology from others, expenditure on activities associated with new product/ process, intangible assets, expenditure on marketing, expenditure on employee training for development of technological skills and managerial and organisational change (Smith, K., 2006, Rogers, 1998). However, some of the indicators of R&D and patents were considered controversial, as sometimes the number of patents may not give an absolute advantage to the firm in the market.

There are other theories of innovation used in the development of indicators. Kline and Rosenberg (1986) made considerable progress in the development of innovation indicators. Their Chain-Link model of innovation looked at the various aspects of innovation and stressed that innovation can also be seen in the small changes in the product performance over a period of time; therefore, an indicator should not overlook these changes. They also emphasised the non-R&D inputs to innovation and are of the opinion there have to be indicators to measure the various inputs like design activities, engineering development and experimentation, training, exploration of markets for new products (Smith, 2005).

Cosh et al. (2005) describe a simple model of innovation propensity for a small business as well as measures for innovation efficiency. Innovation efficiency measures – how well companies convert inputs to outputs – are: 1) Number of employees; 2) Number of employees currently engaged in R&D (in full-time equivalents); 3) Percentage of employees classified as scientists and high professionals; 4) Percentage of new or improved products the company sold in the last financial year. Measures 1, 2 and 3 are clearly innovation inputs, while 4 is an innovation output.

Freel (2005a) described innovation output (i.e., innovation intensity) as a function of proportionate R&D expenditure, the proportionate employment of qualified scientists and engineers and technicians and the existence of innovation-based cooperative relationships with a variety of external agents. Freel concurred with Cosh that Innovation output (i.e. innovation intensity) is viewed as a function of proportionate R&D expenditure, the proportionate employment of qualified scientists and engineers and technicians and the existence of innovation-based, cooperative relationships with a variety of external agents. Tales and Andreassi (2003) also found that innovation output in SMEs appeared related to strategic alliances and public support.

Cosh and Hughes (2002) found, in a study of UK SMEs, that past innovation is positively related to future growth but that the impact of innovation on profitability is less clear cut. Increased profitability and longevity of the business are much more difficult to measure and are not immediately obvious.

Hollanders and Esser (2007)'s study define innovation output variables in econometric terms at regional and national levels has no doubt advanced the field significantly; however, there are very few studies that relate innovation inputs and outputs (as manifested by recognisable outputs for a SME) at a practitioner level for collaborative projects. Their study of innovation outputs at the country level provides us with a basis on which to search for company-level measures of innovation. Hollanders and Esser (2007) uses two categories of measures for innovation output, 'applications' and 'intellectual property'.

Commensurate with the earlier work of Hollanders and Esser (2007) the most recent European innovation scoreboard embraces six economic effects that can be translated at a

company level (UNU-MERIT, 2009). These are: Employment in medium-high and high-tech manufacturing (% of workforce); Employment in knowledge-intensive services (% of workforce); Medium- and high-tech manufacturing exports (% of total exports); Knowledge-intensive services exports (% of total services exports); New-to-market sales (% of turnover); New-to-firm sales (% of turnover). Suitable company-level measures would be the following: A change in employment due to the innovation; A change in exports due to the innovation; A change in New-to-market sales due to the innovation; A change in New-to-firm sales due to the innovation.

Adams et al. (2008a) proposed innovation output measures at the firm level based on a small survey of ICT firms. These are:

- Financial performance – sales and profitability arising from the innovation;
- Business performance – new customers and markets reached by the innovation;
- Innovativeness – new products and services launched;
- Knowledge conversion – reflecting new businesses created as a result of technological/ knowledge development, and;
- Knowledge utilisation – how effectively is the firm incorporating its knowledge assets into its product/ service development.

The literature points to the fact that in order to innovate, a small firm has to depend extensively on the interaction with its environment. The innovation indicators are both hard (R&D, Marketing, Business environment, Financial) and soft (HR- and leadership-related). Ambiguity remains in whether innovation addresses implementation of new ideas alone or whether something is only innovative if it is immediately profitable for the company that makes it. The latter definition appears to ignore spill-over effects of the process of innovation. The definition of innovation, although variable across the literature, hinges upon the concept of ‘successful’ implementation. As success for a small company can be measured in terms of profit, growth or longevity, then innovations that lead to this over time should be taken into account when considering innovation indicators.

A strategy involving all the actors in the innovation process and to maximise their contribution will help the firm to carry out the innovation successfully. The risk and the time taken for the successful implementation of the innovation also depends on the

complexity of the innovation being carried out. The complexity in turn is determined by the dimensions of the innovation and the newness of technology and market (Goffin and Mitchell, 2010).

The next section discusses the concept of innovation strategy and evaluates the literature on innovation management and innovation strategy models.

## 2.4. Innovation Strategy

According to Oke et al. (2012b), firms need innovation strategies to achieve successful innovation outcomes. There are case studies which have ascribed the failure of a firm to its lack of direction and innovation strategy (Cooper and Edgett, 2010). Outcomes of many studies in recent years have associated firm performance with the synergy between technological and non-technological innovation activities. There are constant uncertainties a firm faces both internally and externally and the best way to counter and manage these uncertainties is to increase its performance by adopting the best possible strategy and deploying the available resources appropriately (Oke et al., 2012b, Donaldson and O'Toole, 2007).

It is argued that an innovation strategy helps a firm to adapt to the changes in its environmental circumstances and plays an important role in enhancing business performance, and also reduces a performance gap that might have emerged from changes in environmental circumstances (Morgan and Berthon, 2008, Song et al., 1999).

A firm needs to manage its innovation, and the best way to do it is by implementing an appropriate strategy to accomplish the main aim of its innovation. This demands both internal and external efforts by the firm to organise their R&D activity strategically and a thorough scanning of the external environment (Kim et al., 1993).

There are two key approaches to strategy formation: the planning approach and the emergent approach. The planning approach advocates a very formal process with distinct steps to follow, while making decisions to form a strategy, whereas the emergent approach is of the opinion that strategy emerges from the more flexible environment of the firm over a period of time (Fletcher and Harris, 2002). The basic steps for the planning approach were provided by Ansoff (1957) and Johnson (1986), whereas Mintzberg (1979) has

provided an alternative, emergent approach. The emergent perspective of strategy is more appropriate in the context of small firms, since they acknowledge and enable the advantages of “flexibility, adaptability and dynamism,” which are the main strengths of a SME (Fletcher and Harris, 2002). Fletcher and Harris (2002)’s research work shows high-growth firms use both approaches in their strategy formation and they are of the strong opinion that small businesses are not reactive but are proactive in recognising their strategic needs.

There is no consensus about a positive relationship between strategic planning and firms’ performances. In fact, the differences in the results could be mainly attributed to considerable differences in methodological and theoretical approaches in previous studies (Fletcher and Harris, 2002, McKiernan, 1997). However, there is a general notion that small and medium businesses look for a strategic process only as a reaction to environmental changes rather than being proactive. This assumption was dismissed by many studies and there is an acknowledgement that small and medium businesses, especially the high-technology ones, do recognise the importance of being proactive in forming a strategy for the success of their business (Chan and Foster, 2001).

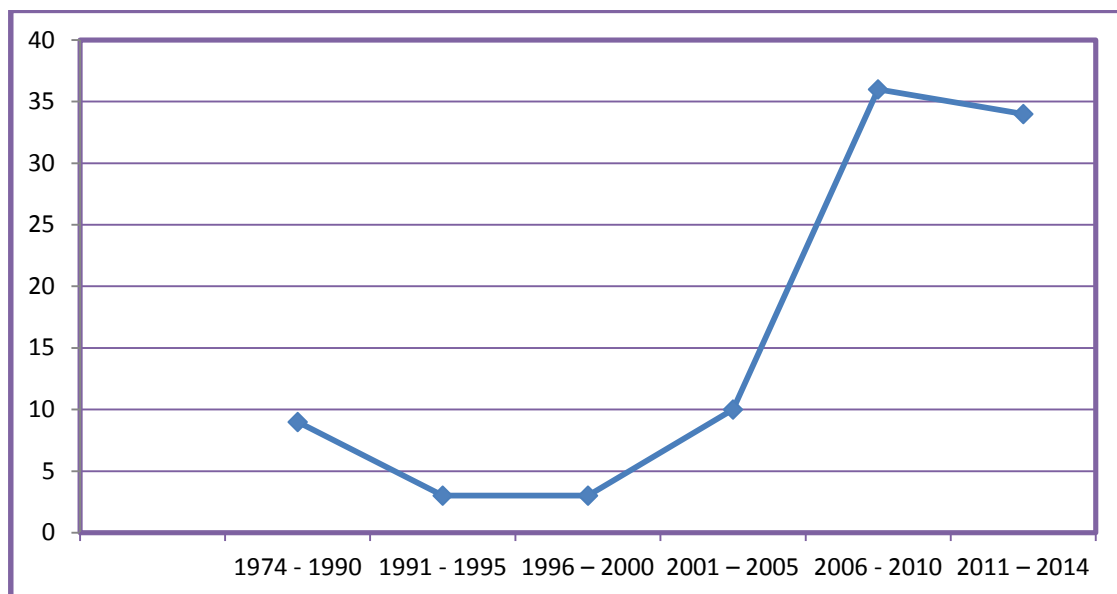
The resource-based view and dynamic capability theory have contributed immensely to the study of strategy at the firm level. Many scholars are of the opinion that both of them are different branches of the same tree (Denrell, 2003, Helfat and Peteraf, 2003).

According to Hodgetts and Kuratko (2001), strategic planning is one of the factors which contribute to the performance of an organisation and it reduces uncertainty by creating a better understanding of the environment. Their research showed 83% of small enterprises do plan formally. Kraus et al. (2006) showed there is a positive relationship between strategic planning and performance.

Though the term “innovation strategy” has been studied in various dimensions over the years, there is no single, scientifically scrutinized and established concept and definition. The study of innovation strategy lacks consistency in its definition, approach and in the elements that makes an integral part of the innovation strategy. This can be attributed to the multiplicity of approaches taken to study innovation and strategy, which has formed the basis for the study of innovation strategy. Innovation has been studied at various levels

like firm, industry and economics, whereas strategy has been studied from a planning or emergent approach. The diversity in the study of innovation also comes from the different methods and tools used to study and measure innovation (Downs Jr and Mohr, 1976).

Another reason for this can be attributed to the speed with which the whole concept of innovation is evolving. However, there is a notable increase in the effort made to systematically understand and establish the concept, in the last ten to fifteen years, which has intensified in the last five years. This can be proved by the number of publications on the systematic study of innovation strategy as a separate entity in itself. During this study, the key words used for the search of existing academic journal articles were: “innovation strategy”, “innovation management”, “technological strategy”, “technological innovation” and “R&D strategy”. However, searching for the journal articles on business source premier search engine, using “innovation strategy” as a keyword produced 95 articles. Figure 2.7 shows the research intensity and journal articles on innovation strategy published over the years. It is noted, though first article was published in 1974, there is a rise in publishing of journal articles in the last decade from 2006.

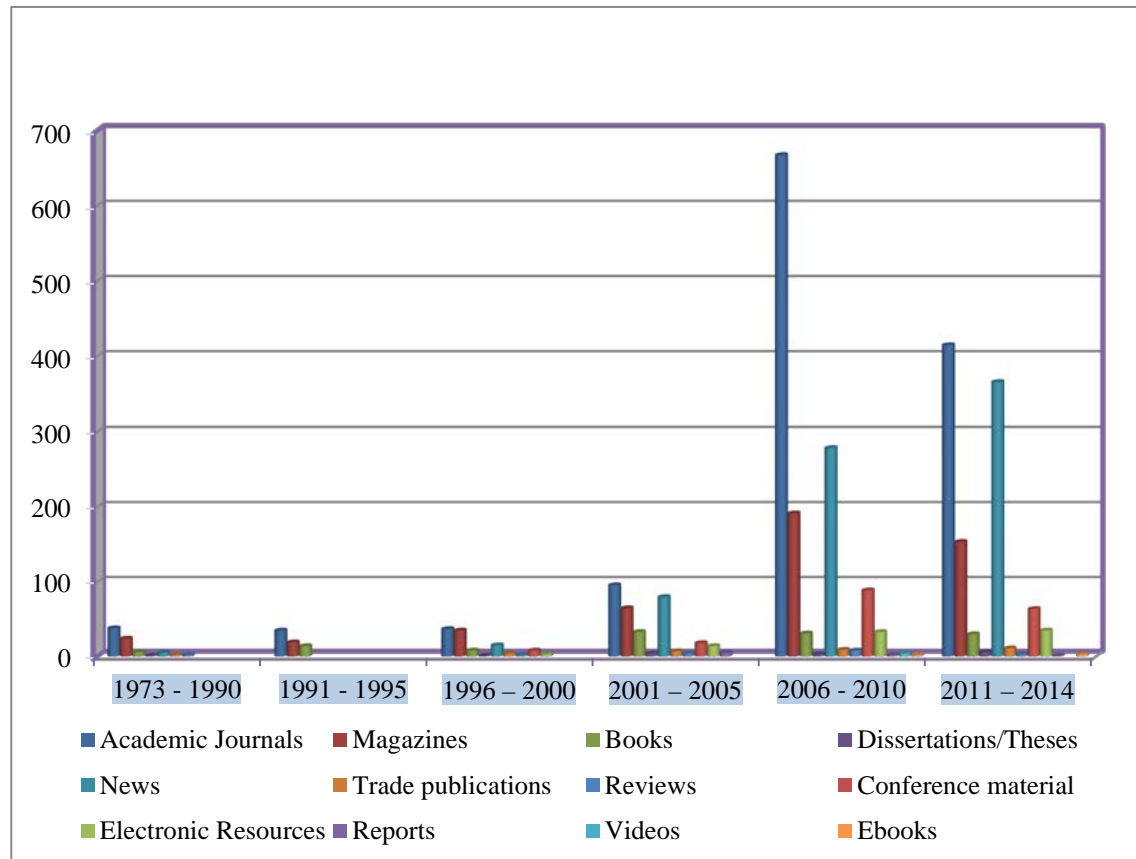


**Figure 2.7: Results from Business Source Premier for Academic Journals on Innovation Strategy**

Note: 5 year groups, except for the first group which is 15 years

Searching on the another academic search engine Discover, publications on innovation strategy has given 2,993 results in various formats, of which 1,289 journal articles were

shown. Figure 2.7 shows the research intensity in publications on innovation strategy published over the years 1974 to 2014. It is noted, though the first article was published in 1973, there is a sharp rise in the publishing of journal articles in the last decade from 2005. Figure 2.8 shows the breakdown of publications by type.



**Figure 2.8: Results from Discover Search Engine for various publications on Innovation Strategy**  
Note: 5 year groups, except for the first group which is 15 years

Innovation and innovation strategy has been studied from economic, social and organisational perceptions and these specific disciplinary groups perceived innovation differently (Stankevicius and Jucevicius, 2012). It is also studied at national and regional policy levels, as well as at firm level. Innovation strategy will therefore mean different things to different researchers, depending upon the unit of analysis and depending upon the lens through which it is being researched. Successful innovation strategy for an economic cluster will be different to that for an isolated firm. The resource-based view of the firm predicts that deployment of resources affects growth, but it is obvious that these two units of analysis will have very different resources.

Developing an innovation strategy helps the firm in strengthening its knowledge about science and technology, customers and markets, available finance, competition, suppliers



and regulations. This knowledge helps the firm to understand better the things that it can do and cannot do, and its innovation capabilities which shape the innovation strategy and their innovation process (Dodgson et al., 2008). An innovation strategy determines to what degree and in what way a firm attempts to use innovation to execute its business strategy and improve its performance. Strategizing the activities of innovation and executing an innovation strategy enables the firm to be focused on its drive to achieve their innovation objectives.

#### 2.4.1. Definition of Innovation Strategy

According to David Smith (2010), “an innovation strategy is a strategy for carrying out innovation”. An innovation strategy is an integral part of an overall strategy and helps to determine the role of the innovation to achieve the aims of the firm (Goffin and Mitchell, 2005b). It helps the firm not only in successfully realising an innovative idea, but also in exciting the customers, outperforming the competitors and building a new product portfolio (Bowonder et al., 2010). Stankevicius and Jucevicius (2010) have described it as an “integrated, overreaching concept of how the firm will achieve its objectives” of innovation activity. The firm needs to evaluate the market trends and assess the importance of innovation to exploit the market needs, the resources and technological expertise to be acquired to realise the innovation. It is important to communicate the role of innovation within the company and to match the resources to the strategy (Goffin and Mitchell, 2005b).

Though there are very limited literature which has defined innovation strategy in clear terms, in recent years many of the researchers have defined the term which have been listed in Table 2.4.

**Table 2.4: Definitions of Innovation Strategy**

Author	Definition
Smith (2010)	An innovation strategy is a strategy for carrying out innovation.
Stankevice and Jucevicius (2010)	Innovation strategy is an integrated, overarching concept of how the firm will achieve its objectives of innovation activity.
Frenz and Lambert (2010)	Open Innovation strategy needs to be the results of at least two strategies, involving the mutually beneficial meeting of in-bound and out-bound open innovators, i.e., resource inputs and external linkages.
Tidd and Bessant (2014)	Innovation strategy is to address the uncertainties and risks, that are inherent in innovation, by having a clear sense of direction and a framework within which to make decisions about the changes an organisation has to make.

According to Stankevice and Jucevicius (2012), the concept of innovation strategy addresses two points: numerous possibilities to innovate and how to facilitate the innovation. The innovation strategy needs to have clarity as to whether to innovate a product, a process, an organisational structure or marketing. It also includes incremental, radical, revolutionary innovation, level of openness, speed and scope of innovation, the ways to reach the target customers, partners etc. (Stankevice and Jucevicius, 2012).

For a firm to realise its novel and new ideas, it has to have a strategic approach in order to understand customers' needs and its target market. It also has to exploit available resources and build competitive capabilities by appropriately matching its resources to the strategy (Goffin and Mitchell, 2005b). To have a successful innovation strategy, a firm needs to have a strong faith in its internal resources and environment, which are going to determine the competitiveness of the firm (Hine and Ryan, 1999). Organisational theories have stated time and again, there cannot be one single design to cover all organisational needs and firms need to make sure they do not focus on just one idea of innovation. It is necessary to prioritise the critical activities that are needed to be carried out in alignment with their limited sources, to realise their innovation. Some of the key aspects identified as internal environment are organisational structure, resources, climate and culture (Tang, 1998). This view is echoed by Tidd et al. (2005 ) and Teece et al. (1997) whose innovation strategy/strategy model proposed three factors which influence innovation strategy: 1) competitive and national positions, 2) technological paths, and 3) organisational and managerial processes (Tidd et al., 2005 , Teece et al., 1997).

#### 2.4.2. Resource-Based View and Innovation Strategy

The conceptual frameworks for the analysis of innovation-related research works are associated with imperfect information, heterogeneity of resources and a competitive environment which is non-deterministic (Henard and McFadyen, 2012b). An RBV of the firm emphasises the appropriate utilisation of available resources by a firm to achieve success in the marketplace and the theory credits the success of the firm, at least partially, to the unique resources of the firm (Peteraf, 1993, Barney et al., 2001, Penrose, 1959). Firm resources could be tangible (e.g. raw material, assets, equipment and capital) or intangible (e.g. reputation, employee skills, and brand equity). RBV theory proposes that appropriate commitment and utilisation of both types of resources available with the firm can lead to positive returns.

The RBV has emerged as an important contemporary approach to strategy, that has been built on existing theories (Foss, 1997). It incorporates the neoclassical view on firms as well as industrial organisation economics. Neoclassical economics considers firms as the bundle of resources, whereas industrial organisation economics argues that a persistent return on investment can be realised through appropriate strategy. RBV does not confirm with the idea of cost-less resource mobility or static environment, but emphasises the possession of resources and the firm's commitment to appropriate utilisation of these resources (Henard and McFadyen, 2012b).

There are two perspectives of RBV: the internal perspective establishes a link between a firm's performance level and its unique set of resources along with its capabilities. The internal routines of a firm establish a conducive environment for innovation. The relational perspectives are of the opinion that critical resources of a firm are not just internal but go beyond the boundaries of a firm. The collaborative linkages between firms have the ability to generate further returns and these strategic assets can have an impact on the innovation environment through knowledge-sharing (Dyer and Singh, 1998, Gulati et al., 2000).

Firms' strategies and their routines are heterogeneous in nature (Peteraf, 1993, Nelson, 1991). They also produce a heterogeneous performance as each firm has different resources at their disposal, as some of these resources are non-transferable, scarce, difficult to imitate, or they cannot be perfectly substituted. Definitions of its resources and capabilities include – "... all assets, knowledge, capabilities, firm attributes, organizational

processes, information, etc.”, are controlled by a firm which enables the firm to conceive the plan and implement strategies, for improving its efficiency and effectiveness” (Barney et al., 2001). The level of organisational capabilities of a firm combined with its capability to reconfigure and sustain its resources and competencies dynamically in response to the external environment will play an important role in determining its decision to innovate (Teece, 2007).

The innovation strategy of a firm is dependent on its existing capabilities in terms of its knowledge stock. There is a high correlation between innovation capability and innovation strategy and they both depend on the resources and competences which are both internally and externally generated (Hervas-Oliver et al., 2014).

The classical question on key resources has always been what valuable resources a firm possesses. RBV shifted this focus to include how well these firms utilise the valuable resources. It is strategically important for a firm to possess resources to be able to utilise them appropriately. However, not all resources can guarantee a sustainable return to the firm. To extract the maximum sustainable returns, the resources must have four key attributes: 1) Valuable, i.e., they should possess a certain value which can be used to exploit available competitive opportunities and counter competitive threats. 2) Rare, i.e., they should not be easily available at least within the competitive environment of the firm. 3) Imperfectly imitable, i.e., competitors should not be able to duplicate the resource easily. 4). Non-substitutable, i.e., there should not be a strategically equivalent substitute (Barney, 2001).

Reed and DeFillippi (1990) argue that internal employee and employers’ skills, internal relationships and deployment of resources can be unclear to the competitors, which can raise barriers to imitation. This “causal ambiguity” which is transaction-specific, can become a firm’s specific competencies, which can be rare and imperfectly imitable. Possession of resources is not mutually exclusive to its utilisation, which raises the importance of resource deployment skills of managers and entrepreneurs.

Cohen and Levinthal (1990) have looked at the new product development (NPD) initiatives of the firm. They argue that the firms which invest in NPD will be more capable of exploiting marketplace opportunities. Though developing such unique resources takes

time and there will be an uncertainty factor, over a period of time, a firm's exploitive capabilities will increase with continued investment. The dedicated deployment of human and financial resources in R&D for new product development initiatives will help the firm to develop core competencies which would be firm-specific. Both tangible and intangible resources are important for the development of core competencies.

For high-technology firms, which are innovation intensive, technical knowledge is one of the critical strategic resources that they must develop or acquire. The most effective way of possessing these resources is having in-house R&D activity. R&D activities are effective not only in developing products and services, but also for effective monitoring of competitors and the latest technological developments in the market (Cohen and Levinthal, 1990, Hage and Alter, 1997). In-house R&D activity empowers firms to develop higher levels of heterogeneous resources and increase knowledge about technological opportunities which will result in more innovation and a higher level of economic performance (Romijn and Albu, 2002, Freel, 2003). The large part of the knowledge base of a firm is embodied within their employees and better employee skills and training programmes can result in better innovation performance (Hadjimanolis, 2000). For high-technology firms, the availability of university-educated and technically-trained people is crucial for their success. It is also important in an SME for the entrepreneur or the manager to create an environment where employees are encouraged to be involved in the various stages of the innovation process. Knowledge exchange, appropriate training to enhance technical skills as well as to facilitate learning, clear communication of the innovation strategy among all the stakeholders and superior managerial competencies will enable high-technology SMEs to accumulate better innovative competencies (Hatch and Dyer, 2004, Hitt et al., 2001, Romijn and Albu, 2002).

#### 2.4.3. Innovation Strategy and Dynamic Capabilities

Resource-picking and capability-building are the two distinct mechanisms in the strategic management literature. Resource-picking is discussed in the previous section and capability-building is discussed in this section.

Innovation success is determined by both micro and macro environment factors. Innovation works in a system and the components of the system could be individuals, markets, enterprises, industries or public/ private organisations. The main objective of an

innovation system is to develop, diffuse and make use of a technology, which has an economic value (Carlsson et al., 2002). The ability of a firm to identify a business opportunity and to exploit it successfully is called economic competence and this relies on four types of capability: strategic capability, organisational ability, learning or adaptive ability and technical or functional ability (Carlsson, 1997, Carlsson, 2003).

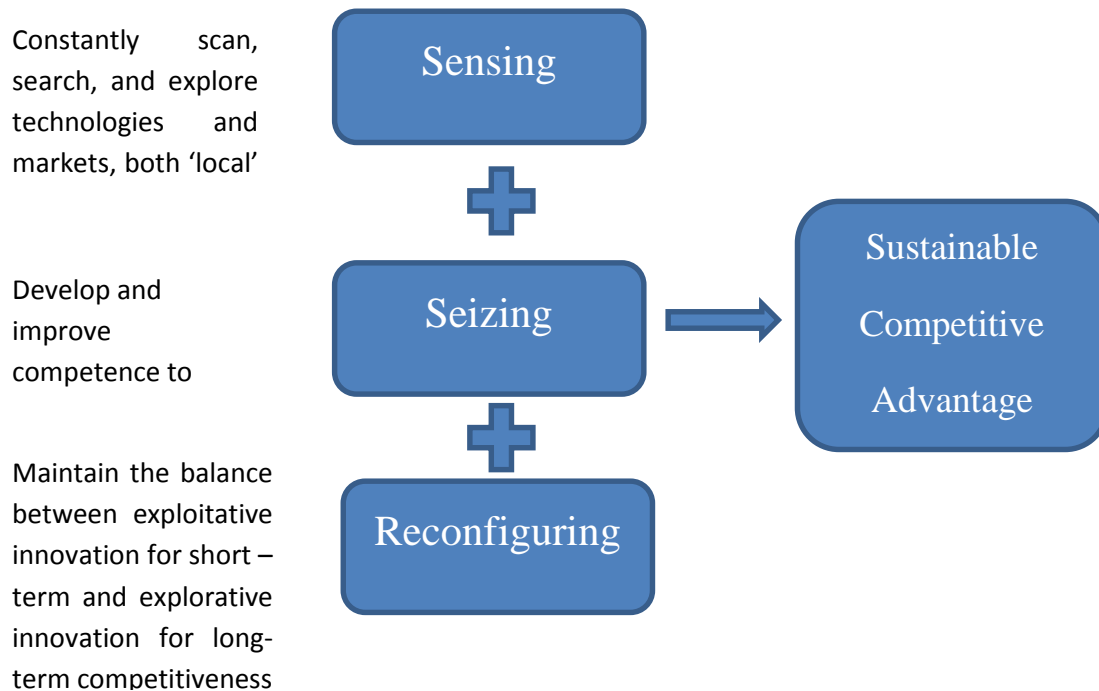
Strategic capability describes the ability of a firm to carry out innovative adoption of technologies, products and markets. This also includes organisational structure, entrepreneurial activities, acquisition of key resources and competencies, appropriate assessment of relevant technologies, market opportunities and threats, and economic situation. It is also about creating an environment to keep the progress of the innovation activities as per the plan. Organisational ability is also called integrative or coordinating ability. The managers or an entrepreneur in a small firm plays the role of a coordinator, who has a clarity of vision and plan to achieve that vision. The organisation should have the ability to align all activities, capabilities and resources of the firm in order to achieve the aim and objectives of the innovation as well as the organisation. The technical ability is about carrying out various activities with efficiency, for successful implementation and commercialisation of technologies, with an operational market application. The adaptive or learning ability is about a firm's capability to learn from examples to protect the organisation from any possible disaster scenarios (Carlsson et al., 2002).

For an effective development and commercialisation of the innovation, it is not enough to possess capability, but the firm has to be effective and dynamic while interacting with external as well as internal resources and capabilities. The Schumpeterian view on dynamic capability suggested the building of a mechanism for capability-building, which is different from resource-picking (Schumpeter, 1950, Makadok, 2001). To have clarity on the "capability building mechanism", It is important to differentiate between the term "resource" and "capability." As defined by Amit and Schoemaker (1993), "Capability is the capacity of the firm to deploy resources through an organisation process, to achieve a desired end. They can be tangible or intangible processes and are firm specific which are developed through a complex interaction among the firm's resources". Capability is firm-specific and is embedded in the organisation and it cannot be transferred, whereas resources can be transferred.

Dynamic capability theory suggests that organisational practice has an ability to sense changes in the market, capitalise on the emerging opportunity through absorbing new knowledge, and reconfiguring the resources continuously with the help of an innovation strategy to withstand a competitive advantage both in long as well as short terms (Albeshier, 2014b).

Eisenhardt and Martin (2000) described dynamic capabilities as the “organisation and strategic routines through which firms attain new resources and configurations as market emerge, collide, split, evolve and die”. There is an intrinsic link between dynamic capabilities and market dynamism. However, RBV, which is a static model might not be able to sustain its competitive advantage within a dynamic market (Wang and Ahmed, 2007, Eisenhardt and Martin, 2000). Dynamic capabilities help to shape operational capabilities and are more associated with the changes that are associated with new product, process or market development (Winter, 2003).

Teece (2007) presented a holistic view (see Figure 2.9) about dynamic capabilities and argued that sensing and seizing an opportunity, and reconfiguring capabilities, are an absolute essential for maintaining a sustainable competitive advantage both in the long run as well as in the short term. Sensing empowers the firm to scan for emerging opportunities in the market, which helps the firm to have a greater awareness about emerging technologies. The capability of seizing helps the firm to develop its internal capability to respond quickly to capture the emerging opportunities in the market. The reconfiguring capability is the strategic mindset, that helps to configure and reconfigure firms’ resources and competencies to strike a balance between short-term profits with a stabilised practice to maximise the profit through existing products and services and a long-term practice which is costly and can only be realised through the search for innovative new products which will help to sustain a competitive advantage in the long-term.



**Figure 2.9: Dynamic Capabilities Model**

Source: Teece (2007)

#### 2.4.4. Innovation strategy taxonomies

Innovation strategy studies have proposed several taxonomies to explore and measure innovation strategy. These studies have adopted Miles and Snow's typology and Porter's strategic typology (Song and Dyer, 1998, Gimenez, 2000, Zahra, 1989, Zahra, 1996, Mariadoss et al., 2011). The studies on innovation strategy taxonomies have also been based on the resource-based view which looks at the internal resources of the organisation in strategy formation to gain competitive advantage in the market and the industry (Terziovski, 2010a, Poon and MacPherson, 2005, Wei and Wang, 2011, Christensen, 1995).

Clausen et al. (2012) identified taxonomy of five innovation strategies based on how intensively a firm uses a number of innovation-related input factors, and pursues a number of innovation goals. The main theme of the study was to look at the innovation strategy of a persistent innovator. Here, innovation strategy is considered as a source for persistent innovation and these were grouped into five categories: ad hoc group, supplier-based strategy, market-driven innovation strategy, R&D-intensive strategy, and science-based innovators (Clausen et al., 2012).



Frenz and Lambert (2010)'s important research defined innovation strategy as a mixed pack of activities which are carried out by a firm to create or market "new goods or services, or improved on production delivery and business process". The study identified five modes of innovation strategy: R&D-based, Marketing-based, Process-based, Management and business strategy-based and Networking-based (Frenz and Lambert, 2010).

Branzei and Vertinsky (2006) proposed a two-dimensional typology of dynamic capabilities, based on life-cycle stage and timing of expected returns. Other classifications of innovation strategy are 'first mover' and 'follower/imitator' (Smith, D. 2006), 'Explorative and Exploitative' (Morgan and Berthon, 2008), 'Radical/destructive and Incremental' (Moller et al., 2008).

The literature on innovation and innovation strategy in SMEs suggests that SMEs face difficulties in fostering innovation with an innovation strategy due to their limited organisational resource and supporting system (McEvily et al., 2004). It also suggests that, because of the nature of the indicators, innovation strategy may not be explicit in most SMEs but may need to be sought out. Many indicators provide insight into whether an 'innovation strategy' is actually in place. These indicators, however, may often be implicit within a small business; requiring additional research resources.

SMEs' contribution to innovation and economic growth is one of the important topics discussed in the twentieth century literature of both economics and operations management (Storey, 1994a, Taylor and Cosenza, 1997, De Geus, 1997, Rothwell, 1994). Although SMEs have many constraints in carrying out innovation, their size gives them some advantages over the larger companies, and this can sometimes lead SMEs to be more innovative. Their strong internal communication, entrepreneurial management style and close customer relationships helps them to react quickly to any technical and market changes (Scozzi et al., 2005, Rothwell, 1994).

On the other hand, they have many obstacles like financial constraints, existing knowledge, access to skilled labour, and limited access to market information, and an external linkage which makes it difficult to maintain a consistent innovation process. Another important problem an innovative SME faces is a lack of strategic vision to carry

out the innovation development. It is revealed from the innovation literature that a strategy to carry out a successful innovation helps the firm in three phases of the innovation process, namely, planning, development and learning (Scozzi et al., 2005).

## 2.5. Business Growth and Performance

According to Brush and Vanderwerf (1992), the growth of an enterprise (especially an SME) is perceived as one of the most significant performance indicators. Business growth is dependent on various factors and it is a complex process. Various frameworks to measure business growth are divided into six categories, namely, stochastic, descriptive, evolutionary, resource-based, learning and deterministic (Dobbs and Hamilton, 2007).

Flamholtz (1999)'s framework on organisational growth includes seven stages. In the first stage, market and products are in the developmental stage; in the second stage the focus is on expansion of sales, market share and employees. The third stage focuses on what is called professionalization, where the firm tries to formalise the organisational goal, process and functions. These three stages are considered important from the small business perspective. The other four stages are consolidation, diversification, integration and decline and revitalisation.

Traditionally, growth in small firms has been studied with four main perspectives. They are personal characteristics of the entrepreneur, organisational development, business management and the industry and location (Reijonen and Komppula, 2007).

It is argued that innovation strategies help the firm to adopt to the changes in its environmental circumstances and play an important role in enhancing the business performance and also to reduce a performance gap that might have emerged from changes in environmental circumstances (Morgan and Berthon, 2008, Song et al., 1999).

According to Hodgetts and Kuratko (2001), strategic planning is one of the factors which contributes to the performance of an organisation; it reduces uncertainty by creating a better understanding of the environment. Their research showed 83% of small enterprises do plan formally. Kraus et al. (2006)'s research showed there is a positive relationship between strategic planning and performance.

The growth of the firm cannot be assessed just with growth indicators, since this fails to look at the other strengths of the firm, which when nourished, can tremendously help the company to grow. When looking at the growth of the firm, the researcher needs to look at the current growth indicators as well as the future growth indicators, which are closely related to innovation strategy and performance indicators.

## 2.6. High-Technology SMEs

The importance of high-technology SMEs to the economic prosperity of a nation has been acknowledged by many scholars (Wever and Stam, 1999, Oakey and Mukhtar, 1999, Yoo et al., 2012, Mason and Brown, 2013). Technological innovation is an important and vital source of performance and long-term growth (Solow, 1987). Small firms are increasingly becoming the source of new ideas and technological innovations, and larger firms are increasingly partnering with high-technology small firms to introduce or market the new products (James et al., 2014). SMEs in high-technology sectors are receiving much attention lately, from both researchers as well as policy makers, as they are showing great potential to act as mediators of industrial regeneration in both developed as well as developing countries (Romijn and Albaladejo, 2002).

An innovation in an economy is associated with technological leadership and it has become an absolute necessity for national and regional growth. High-technology SMEs are also highly complex as they deal with emerging technology and invest their resources on R&D, which can be an abstract concept in the developmental stage (Steenhuis and De Bruijn, 2006a, Steenhuis and de Bruijn, 2006b).

There are many established research and networking centres, which have become a link between policy makers and high-technology firms. In the UK, the Technology Strategy Board is one such organisation which is trying to foster high-technology firms. Another important high-technology cluster is around Cambridge which hosts cutting-edge technology companies from around the world, which is leveraging its proximity to the world-class university.

Hoffman et al. (1998) carried out a comprehensive study on high-technology firms in the UK and he identified some of the innovative characteristics shown across the industrial sectors:

1. There is more involvement in R&D and product innovation than process innovation,
2. They focus on niche markets,
3. They are involved in producing both incremental as well radical innovation,
4. They often tend to establish external partnerships and linkages,
5. They are high on growth with their output, turnover, and employment.

The study identifies a gap in knowledge of an understating of innovation and its working within high-technology SMEs. It emphasises the need for quantitative measures to evaluate the process of innovation strategy development and innovation management in high-technology SMEs. The research on high-technology SMEs has also called for better understanding of the nature and extent of support needed by these firms and establishing better government policy and delivery mechanism in order to stimulate the innovative path of the these firms (Keizer et al., 2002).

## 2.7. Indicators and Relationships between Indicators

From the literature review, indicators are identified which can be used to measure innovation, innovation strategy and business performance in SMEs.

Most of the innovation and growth indicators can be accessed from outside the company with the available data in the public domain, whereas there are many soft indicators related to innovation strategy and performance which can be found only by interacting with the individual firm.

The main difficulty in identifying an innovative firm and also an innovation strategy lies in the ambiguity of the existing definitions. Further, the lack of resources and the working style of an SME make it difficult to find hard evidence to assess the existence of any innovation strategy and its influence on the growth of the firm.

The economic literature tries to measure innovation and growth through the indicators which may be available from statistical data available from inside as well outside of the firm, whereas the operational management literature looks at the indicators which are mostly only accessible within the firm because they are not generally on public record. The main difference in the viewpoint of these two literatures on measuring innovation and growth of a firm is that the economic literature tends to look at hard indicators like finance and outputs or employment, whereas the operational management literature also includes soft indicators like quality, employee satisfaction or leadership.

Tables 2.5 – 2.8 show indicators for innovation, innovation strategy, business growth and business performance and the literature sources.

**Table 2.5: Innovation Indicators and their literature source**

Code No	Innovation Indicators	Sources
I-1	Acquisition: external idea sourcing, external alliances	Bowonder et al. (2010), Laforet and Tann (2006)
I-2	Extent to which major customers provide specification for new product	O'Regan and Ghobadian (2005), Laforet and Tann (2006)
I-3	Innovation prizes won / public support	Laforet and Tann (2006), Tales and Andreassi (2003), Cosh and Hughes (2002)
I-4	Investment in R&D/ R&D expenditure	Branzei and Vertinsky (2006)
I-5	Level of investment in systems and technology for office	Branzei and Vertinsky (2006), O'Regan et al. (2006)
I-6	Level of investment in systems and technology for shop floor	Laforet and Tann (2006)
I-7	New or improved ways working in last five years	Laforet and Tann (2006)
I-8	No. of new product/services ideas or business model	Laforet and Tann (2006)
I-9	No. of new products improved/Modified existing product	Laforet and Tann (2006), Hollanders and Esser (2007)
I-10	No. of patents	Laforet and Tann (2006), Branzei and Vertinsky (2006), Adams et al. (2008)
I-11	Profitability	Cosh et al. (2005), Battisti et al. (2008), Adams et al. (2008)
I-12	The percentage of sales from the newest product introduced	Cosh et al. (2005, Hollanders and Esser (2007), Adams et al. (2008)

**Table 2.6: Innovation Strategy Indicators and its literature source**

Code No	Innovation Strategy Indicators	Sources
IS-1	Adoption of external technology	Laforet and Tann (2006)
IS-2	Automated Inspection	Laforet and Tann (2006)
IS-3	Bench marking	Laforet and Tann (2006), Adams et al. (2008)
IS-4	CEO involvement in NPD	Laforet and Tann (2006), Branzei and Vertinsky (2006), Morgan and Berthon, (2008), Verbees and Meulenberg, (2004), Reijonen and Komppula (2007)
IS-5	Competitor analysis	Laforet and Tann (2006), Adams et al. (2008)
IS-6	Computer-aided design and drafting	Laforet and Tann (2006, Frank (2004), Verbees and Meulenberg (2004)
IS-7	Development of new process and continuous improvement	Verbees and Meulenberg (2004), Laforet and Tann (2006), Frank (2004)
IS-8	Development of new ways of working	Laforet and Tann (2006, Branzei and Vertinsky (2006)
IS-9	Digital interchange with customers	Laforet and Tann (2006)
IS-10	Employee suggestion scheme	Laforet and Tann (2006)
IS-11	Everyone knows criteria for evaluating new product projects	O'Regan and Ghobadian (2005)
IS-12	Human capital development	O'Regan and Ghobadian (2005)
IS-13	Improve process to add value to the products and services	O'Regan and Ghobadian (2005)
IS-14	Improve process to reduce cost	Morgan and Berthon (2008), Laforet and Tann (2006)
IS-15	In-house market research	Morgan and Berthon (2008)
IS-16	In-house R&D	Morgan and Berthon (2008), Kline and Rosenberg (1986)
IS-17	Innovation feature in company's objective	Laforet and Tann (2006)
IS-18	Market development	Laforet and Tann (2006), Kline and Rosenberg (1986)
IS-19	Networking	Laforet and Tann (2006)
IS-20	New product team takes lead in implementing NPD	Laforet and Tann (2006)
IS-21	Product development	Laforet and Tann (2006), Kline and Rosenberg (1986)
IS-22	Regular Study of competitors	Branzei and Vertinsky (2006), Adams et al. (2008)

IS-23	Regular study of the market	Branzei and Vertinsky (2006), Adams et al. (2008)
IS-24	Staff training	Branzei and Vertinsky (2006), Kline and Rosenberg, (1986)
IS-25	Technology system in place	Branzei and Vertinsky (2006)
IS-26	Training	Branzei and Vertinsky (2006)
IS-27	Percentage of scientists or high-tech professionals employed	Hollanders and Esser (2007), Freel (2005a)
IS-28	No of employees	Cosh et al. (2005)
IS-29	No employees engaged in R&D	Cosh et al. (2005)

**Table 2.7: Performance Indicators and their literature source**

Code No	Performance Indicators	Sources
P-1	Autonomy	Branzei and Vertinsky (2006), Terziovski (2010a)
P-2	Average profits per customer	Morgan and Berthon (2008)
P-3	Capacity utilisation	Branzei and Vertinsky (2006), Terziovski (2010a)
P-4	Customer development	(Adams et al., 2008)
P-5	Customer satisfaction	Singh et al. (2010)
P-6	Degree of innovation	Adams et al. (2008)
P-7	Delivery speed	Morgan and Berthon (2008), Singh et al. (2010)
P-8	Employee motivation	Singh et al. (2010)
P-9	Employee productivity	Singh et al. (2010), Branzei and Vertinsky, 2006)
P-10	Employee satisfaction	Singh et al. (2010)
P-11	Hourly rate	Branzei and Vertinsky (2006)
P-12	Image	Bowonder et al. (2010)
P-13	ISO certificates; quality initiatives	Singh et al. (2010), Bossink (2002)
P-14	Job Satisfaction	Terziovski (2010a), Singh et al. (2010)
P-15	Liquidity	Madrid-Guijarro et al. (2009)
P-16	Market development / market share	Singh et al. (2010), Adams et al. (2008)
P-17	Number of employees / Size	Edelman et al. (2005), Branzei and Vertinsky (2006), Singh et al. (2010)
P-18	Production margin	Singh et al. (2010)
P-19	Profit / Price cost margin	Singh et al. (2010)
P-20	Return of Sale	Morgan and Berthon (2008)

P-21	ROI – return on investment	Morgan and Berthon (2008)
P-22	Sales growth	Morgan and Berthon (2008), Branzei and Vertinsky, 2006)
P-23	Supplier satisfaction	Branzei and Vertinsky (2006), Singh et al. (2010)
P-24	Total margin	Branzei and Vertinsky (2006)
P-25	Turnover	Dobbs and Hamilton (2007), Edelman et al. (2005)

**Table 2.8: Business Growth Indicators and their literature source**

Code No	Business Growth Indicators	Sources
BG-1	Change in asset	Dobbs and Hamilton (2007)
BG-2	Employment	Dobbs and Hamilton (2007)
BG-3	Export	(Singh et al., 2010, Dobbs and Hamilton, 2007, Hollanders and Esser, 2007, Cosh et al., 2005)
BG-4	Financial growth	Dobbs and Hamilton (2007)
BG-5	Market Share	Singh et al. (2010, Adams et al., 2008)
BG-6	Past innovation	Singh et al. (2010)
BG-7	ROI	Singh et al. (2010)
BG-8	Sales	Singh et al. (2010), Dobbs and Hamilton (2007)
BG-9	Size (employment see above)	Barringer and Jones (2004), Terziovski (2010)
BG-10	Technological progress	Barringer and Jones (2004), Dobbs and Hamilton (2007)
BG-11	Total assets (incl patents/copyright etc)	Barringer and Jones (2004), Adams et al. (2008)
BG-12	Turnover on sales	(Dobbs and Hamilton, 2007)

## 2.8. Theoretical Framework Development

An analysis of the literature on innovation, innovation management and innovation strategy has given a greater understanding of the various measures available to understand the factors that make an important part of the innovation strategy. Based on the research questions and the literature, four hypotheses were developed and a theoretical model was proposed for this study.



### 2.8.1. Theoretical foundation of the study

The literature review on RBV, dynamic capability, innovation, innovation strategy and high-technology SMEs has established the importance of innovation management through an exclusive innovation strategy for the business growth of high-technology SMEs. High-technology SMEs have become a success story of economic growth and it is very important they are supported by external factors which can help them to sustain their innovation performance and growth.

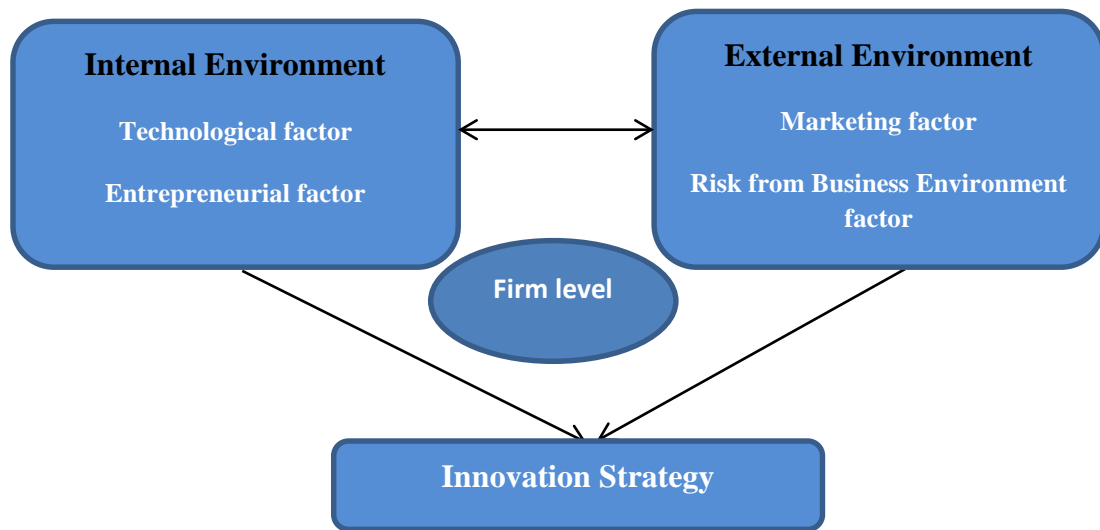
High-technology SMEs use technology in their product development or the process development. Technology is also considered as a valuable resource as well as a capability of the firm which helps the development of an innovation. There is a combination of both radical and incremental innovation and the majority of high-technology SMEs cater to a niche market. Another phenomenon of the majority of high-technology SMEs is they also work with the development of new technology products and services and these products and services are very close to commercial realisation. The nature of high-technology SMEs makes them very vulnerable to pressure from both external and internal environments. Externally, they have to deal with business risk factors like unpredictability of the market, competitors, both at national and international level, government policy with respect to funding support, tax, import and export regulations, etc. At the same time, they also have to deal with the size of their firm which makes them vulnerable with their limited resources in terms of finance, skill development, organisational structure, hierarchy etc. However, it is also noted that the size of the firm, which can be a weakness, is also considered as their greatest strength. This gives them an opportunity for better coordination among their employees, and interaction between owner and employee is very close. This also gives them the capacity to react more quickly to external changes and internally align themselves quick to respond to those external changes.

Innovation is the life-line of high-technology SMEs and it is very important they have clarity about the aims of their innovations. This clarity also needs to be communicated across the organisational structure and they have to be prepared all the time to respond to external changes, as markets are increasingly becoming globalised.

As noted in the literature, innovative high-technology SMEs need to have an innovation strategy in alignment with their overall business strategy. There are frameworks/typologies proposed for an innovation strategy which are based on the resource-based view as well as dynamic capabilities theory (Cooper, 1984, Ramanujam and Mensch, 1985, Gilbert, 1994, Markham and Griffin, 1998, Hauschildt, 2004, Terziovski, 2010, Goedhuys and Veuglers, 2011). This study recognises the importance of both the views and considers both resources and capabilities need to complement each other and should be a part of an innovation strategy.

Resources and dynamic capabilities help to acquire each other. Basic threshold resources are needed to help develop capabilities. However, some of the unique capabilities also can help to acquire unique resources like government funding, partnership, etc. Keeping this in mind, this study proposes a theoretical model which comprises both resources and capabilities, and external and internal factors. However, the study does not make any differentiation between radical and incremental innovation, as the main aim of the study is to develop a framework for an innovation strategy which can be adopted by firms irrespective of the kind and type of innovation. It is important to establish a model which can help to realise all types of innovation, like radical and incremental, explorative and exploitative, product innovation and process innovation.

Based on the above view, a theoretical model which has technological factor, marketing factor, entrepreneurial factor and risk/ business environment factor as the core factors was proposed. Technological factor and entrepreneurial factor are internal factors, whereas marketing factors and risk/ business environment factors are external factors. Technological factor and entrepreneurial factor can be considered as resources, whereas the way a firm responds to marketing factors and risk from business environment can be based on their dynamic capabilities. Figure 2.10 illustrates the basic principle of this research study.



**Figure 2.10: Theoretical foundation for the study**

The four main factors which are incorporated in this theoretical framework were based on the previous works of Grant (1991)’s resource-based approach for strategy analysis, Branzei and Vertinsky (2006)’s two-dimensional typology of dynamic capabilities, Goffin and Mitchell (2005b)’s Innovation Pentathlon Framework and Frenz and Lambert (2010)’s innovation modes. Another study which was the main base for this research study was “innovation strategy and firm performance” by Strecker (2007).

Grant (1991) resource-based approach for strategy analysis is based on the assumption that a firm’s strategy needs to match the internal resources and skills with the external opportunities and risks. Branzei and Vertinsky (2006) model is based on the principle of dynamic capabilities, and it proposes that success of product innovation depends on the firm’s capability to secure and integrate external knowledge, convert this into new and unique ideas and competencies, for then they will be able to reap the benefits of these ideas by creating and efficiently commercialising new or improved products.

Goffin and Mitchell (2005b)’s Innovation Pentathlon Framework is an important framework in the innovation management field which presented a simple representation of the process of innovation implementation. Here, innovation strategy was one of the main factors and it addressed the importance of R&D, market development and organization communication. Frenz and Lambert (2010)’s innovation modes emphasise that the innovation strategy of an innovative firm needs to embrace open innovation as

well as user innovation with concentration on internal development and also with external linkages.

Strecker (2007)'s study on innovation strategy discussed the operationalization of innovation strategy and tried to determine the innovativeness of firms. It looked at market innovativeness and technological innovativeness, which form part of an innovation strategy. This study adopted these variables to measure the technological factor and marketing factor.

Based on these theoretical bases, four hypotheses were developed and each factor was measured by using various items which have been used in the existing literature.

#### 2.8.2. Technological Factor

According to Teece and Pisano (1994), firms “demonstrating timely responsiveness and rapid and flexible product innovation, along with the management capability to effectively co-ordinate and redeploy internal and external competencies” will have greater chance of higher growth. The majority of SMEs, especially high-technology SMEs, are established on a single technological innovation leading to the development of new products or services (Wolpert, 2002). The firm's speed of adoption of the new technology will have a direct effect on business growth. Traditionally, the innovativeness of a firm and its capability to adopt new technology were measured by in-house R&D, No. of employees working in R&D, No. of patents in the last five years, or any process improved to add value to the products and services. However, increasingly, there is a shift in the way high-technology SMEs operate and they many not use established ways like having a R&D department to innovate. Instead, they might be using partnership or external linkages to acquire knowledge (Green and Gavin, 1995).

However, success of new product development is considered as an indicator for strategic as well as the firm's success (Thomas, 1993, Cooper and Kleinschmidt, 1995). It also establishes the superior strategic alliances, deployment of internal resources and development process, and good management of technological ideas (Noke and Hughes, 2010). Song and Montoya-Weiss (2001)'s contingency framework for new product development included technological proficiency as one of the main contributors.

Gatignon and Xuereb (1997) investigated the relationship between strategic orientation and new product performance, identified three kinds of strategic orientation which are important for the success of any innovation in product development. They strongly argue for a firm's strategic orientation to be customer-oriented, competitor-oriented and technological-oriented to achieve an innovation success. High-technology firms are highly innovative and R&D intensive. They are proactive and will always look for ways to acquire sophisticated new technologies which will aid the development of new products or services. Firms which are technology-oriented use their technological capabilities to find new solutions to meet the needs of the market and customers (Cooper, 1984). According to the above studies, technological orientation and technological innovativeness have a positive relationship with firm performance, which in turn helps the growth of the firm.

To measure the technological innovativeness of the firm, the variables were adopted from the previous study of Strecker (2007). These variables were used to measure the firm's level of technological innovativeness, which forms part of an innovation strategy. The statements were formed to measure the degree to which the firms agree or disagree and demonstrate the strategic orientation of the firms.

The technological factor was measured by the following statements:

Tech1	A majority of innovations is based on substantially a core technology never used in our industry.	Strecker (2007)
Tech2	A majority of our innovations involves technology that makes old technologies obsolete.	Strecker (2007)
Tech3	A majority of our innovations uses new technologies that permit quantum leaps in performance.	Strecker (2007)
Tech4	A majority of our innovations use technologies that have an impact on or cause significant changes in the whole industry.	Strecker (2007)
Tech5	A majority of our innovations, uses technologies which represent minor improvements over previous technologies.	Strecker (2007)

Based on these arguments the following hypothesis is proposed.

**Hypothesis 1:** Technological factor has a positive relationship with business growth.

This study proposes a positive relationship between technological factor and business growth.

### 2.8.3. Marketing Factors

Cooper (1984) is one of the early researchers who linked innovation with an effective marketing plan. Subsequently, the influence of marketing orientation and its inclusion in the innovation strategy for the success of any product or service has been discussed by many researchers (Gatignon and Xuereb, 1997, Cooper, 1994, Lopes et al., 2012). Management of innovation needs to monitor technology and market in order to be commercially successful. According to Teirlinck and Spithoven (2013), R&D management in SMEs is linked to a more complex relationship between “Internal innovation strength and firm’s external environment”. The success of the innovation is closely related to the dynamics of strategic decisions and the way the market positioning of the products or services is envisioned. Success of innovation depends on market pull factors as much as it depends on technological push factor (Brockhoff and Chakrabarti, 1988). It is also very important that a firm has an effective communication channel is established between R&D and the marketing department to ensure there is an effective information flow which helps the development or modification of the product on the basis of market intelligence and to establish that highly competitive product support services are established, which helps the success of the product (Song and Dyer, 1995).

A firm’s strategic orientation needs to include customer and competitor and this has to be included in the strategic orientation of the innovation (Gatignon and Xuereb, 1997). Strategy can be viewed as building defences against the competition. Michael Porter’s famous Five Forces of Competitive Position model provides a simple perspective for assessing and analysing the competitive strength and position of a corporation or business organisation. The model emphasises holding superior positions against competitive forces like consumers, suppliers, competitors, substitutes and potential entrants; to have a superior power against a competitor marketing factors have a direct effect on the business

growth of the firm. The variables to measure marketing factors are competitor analysis, size of competitors and their bargaining power, threat of substitute products and threat of new market entrants (Porter, 1980).

Dynamic capabilities play an important role in responding to the external changes in terms of technology and changing characteristics of a market. These external pressures and a firm's ability to respond to these pressures through internal activities determine the life cycles of the new products and services, as new technologies can make the existing technology obsolete and also can create a new substitute (Teirlinck and Spithoven, 2013).

The portfolio model of determinants of innovation proposed by Souitaris (2002) identifies "Scanning of external information" as one of the four key factors that is routinely associated with innovativeness. The scanning can be carried out using various channels and methods such as market research, networking, monitoring the competitor, attending trade fairs etc.

To measure the marketing innovativeness of the firm, the variables were adopted from the previous study of Strecker (2007). These variables were used to measure the firmness level marketing innovativeness which makes the part of an innovation strategy. The statements were formed to measure the degree to which the firms agree or disagree and demonstrate the strategic orientation of the firms.

The marketing factor was measured by the following statements:

- |      |   |                 |
|------|---|-----------------|
| MAK1 | The majority of our innovations address completely new customer benefits.   | Strecker (2007) |
| MAK2 | The majority of our innovations offer our customers the unique advantage over competitors' products.                | Strecker (2007) |
| MAK3 | The majority of our innovations require changes in established attitude and behavioural pattern from our customers. | Strecker (2007) |

MAK4	Our mainstream customers require major learning efforts to use the majority of our innovations.	Strecker (2007)
MAK5	The majority of our innovations involve high switching costs for our mainstream customers.	Strecker (2007)
MAK6	The majority of our innovations are similar to our main competitors' products.	Strecker (2007)
MAK7	We have the ability to introduce new products more quickly than our competitors.	Strecker (2007)
MAK8	We have the ability to customise products to individual customers' needs.	Strecker (2007)

Based on the above arguments, the second hypothesis is proposed as follows:

**Hypothesis 2:** Marketing factor has a positive relationship with business growth

This study proposes a positive relationship between marketing factor and business growth.

#### 2.8.4. Entrepreneurial factor

High-technology SMEs thrive on the success of innovation and to achieve this they need excellent leaders who have the right experience and attitude to foster innovative ideas and create the right conditions to nurture the innovation. Entrepreneurial behaviour is considered as an important contributing factor in the growth of small businesses (Kozan et al., 2012). In SMEs, entrepreneurs and top management have greater power in deciding the future course of the firm, and influence the strategic direction and choices of the organisation. Many of the decisions are also influenced by the personal preferences of the managers at multiple levels (Chen et al., 2010).

SMEs have a unique organisational structure which has its advantages in creating a better environment for innovation success. The size of the firm helps them to establish an uncomplicated organisational structure and simple communication channels, and this in turn allows the top management of an SME to interact better with all the stakeholders and



firm's resources (Kor, 2006). Entrepreneurship research has linked the entrepreneurial orientation and attitudes to the performance of the firm and considers innovation as an integral part of entrepreneurship. (Avlonitis and Salavou, 2007). High-technology SMEs depend on continuous innovation in products or services for their survival and entrepreneurial orientation plays an important role in steering the innovation in the right direction. The entrepreneurial factor has been identified as one of the important strategic drivers of product and service innovation and has a positive effect on innovativeness and breakthrough innovation. Entrepreneurial characteristics, such as foresight and orientation, have been considered as an important factor that determines the strength of the firm in competing with present and future competitors. It also establishes the clear vision for the firm to be successful (Hamel and Prahalad, 1994, Avlonitis and Salavou, 2007). An entrepreneurial-oriented culture encourages more openness to customer needs and helps to create a long-term commitment for innovation and establish a clear vision for the success of the innovation as well as the firm's growth (Nasution et al., 2011).

High-technology SMEs use product innovation as a competitive strategy for their survival and this has been supported by entrepreneurial orientation (Salavou and Lioukas, 2003). Traditionally, the debate over strategic determinants considered market-pull and technology-push. However, Salavou and Lioukas (2003)'s work considered entrepreneurial push as one of the driving forces which is strategically very important in fuelling innovative activities, particularly in SMEs. This is established by the pro-activeness and risk-taking attitude of entrepreneurs.

This third factor in this study is based on the character traits of an entrepreneur/ owner-manager and leadership factors which have a direct effect on the business growth of the firm. The factor is by various items which are adopted from various studies.

The entrepreneurial factor was measured by the following statements:

ENP1	The CEO is involved in new product/service development.	(Laforet and Tann, 2006, Branzei and Vertinsky, 2006, Morgan and Berthon, 2008, Verbees and Meulenberg, 2004, Reijonen and Komppula, 2007)
ENP2	The CEO is committed to building relationships with employees and there is mutual support and trust.	Nasution et al. (2011)
ENP3	The CEO has previous experience with product/services development alliances.	Entrialgo (2002)
ENP4	The company makes innovation happen through strong, clear vision.	Nasution et al. (2011)
ENP5	There is a long term commitment to innovation.	(Cooper and Kleinschmidt, 2007)
ENP6	There is a clear allocation of the resources for the implementation of innovation.	(Cooper and Kleinschmidt, 2007)
ENP7	The CEO encourages change and creates the right climate for the implementation of innovation.	(Cooper and Kleinschmidt, 2007)

Based on the above arguments, the third hypothesis is proposed as follows:

**Hypothesis 3:** Entrepreneurial factor has a positive relationship with business growth.

This study proposes a positive relationship between entrepreneurial factor and business growth.

#### 2.8.5. Risk from Business Environment

Innovation has many stakeholders in the business environment. There are many risks which emerge from the business environment and government policies which will have an influence on the success of the innovation and the business growth of an SME. Firms' prospects for survival and growth are contingent upon their ability to understand their business environment better and make changes to their strategies which can address the potential risks the stakeholders might pose (Audretsch, 1995). Some of the key stakeholders in the external environment are competitors, customers and policy makers.

Innovation has an uncertainty in its nature and most high-technology SMEs which are involved in new product or service development have to make decisions which are very risky and by nature most of the time they are long-term oriented (Kor, 2006). The SMEs, given their limited resources, need to take higher risk and commit significant resources to pursue opportunities amidst uncertainty (Nasution et al., 2011).

The terms risk and uncertainty are used in the literature interchangeably (Susmita Ghosh et al., 2014). Uncertainty is an important aspect of innovation management and needs to be addressed strategically, as it limits SMEs from taking certain entrepreneurial decisions related to new product development, new service development, market assessment, new market development etc. (McMullen and Shepherd, 2006, Susmita Ghosh et al., 2014). The external business environment can be socio-political, economic, technology, competitors, suppliers, customers, government, resources and they could be in groups, institutions or an individual. The uncertainty of the environment is not absolute and the intensity of the risk posed by the environment varies from firm to firm as it is the threat or opportunity perceived by each individual firm depending on their existing resources and capabilities (Downey and Slocum, 1975).

There are risk factors associated with the market, competitors, rate of return, customer relationships, and changes in government policies. Some of the uncertainties also arise from the firm's inability to access the knowledge and information available and can affect their decision making process.

The risk from business environment factor were measured by the following statements:

BGR1	The market has been hostile and unpredictable.	(Freel, 2005b)
BGR2	We have constantly introduced new products and services.	(Laforet and Tann, 2006) (Hollanders and Esser, 2007)
BGR3	When considering business opportunities we prefer a low risk with moderate return to a high risk opportunity with high return.	(Laforet and Tann, 2006) (Hollanders and Esser, 2007)
BGR4	We actively nurture the relationship with our existing customers.	(Freel, 2005b)
BGR5	We actively monitor our competitors.	(Freel, 2005b)
BGR6	Our competitors have the ability to introduce new products more quickly than us.	(Laforet and Tann, 2006), Adams et al. (2008)
BGR 7	We regularly need to make changes to our business operations because of changes in government policies and regulations in the following areas.	
	Tax benefits of the company.	(Freel, 2005b)
	Government funding for R&D.	(Freel, 2005b)
	Foreign direct investment regulations and restrictions.	(Freel, 2005b)
	Import / Export benefits and restrictions.	(Freel, 2005b)
	Intellectual laws which make companies liable to follow the new standards set by government.	(Laforet and Tann, 2006, Branzei and Vertinsky, 2006) Adams et al. (2008)

Based on the above arguments, the fourth hypothesis is proposed as follows:

**Hypothesis 4:** Risk from business environment factor has a positive relationship with business growth.

This study proposes a positive relationship between risk from business environment factor and business growth.

#### 2.8.6. Business Growth

High-technology firms have a greater potential to grow with their capability to innovate continuously and are considered as the lifeline of the modern economy. As noted by Smallbone et al. (1995), high-growth firms are likely to possess more innovative products and they continue to develop new products as well as make improvements to their existing products, to expand their share in the market. There is no one theory which can explain business growth adequately in small business firms, which can be attributed to the heterogeneity that exists in the small firms as well as a range of factors that can influence as well as affect the business growth of SMEs (Coad et al., 2011).

Life-cycle theories' core assumption is that the development of young and new firms is based on their innovation. However, it also highlights "smallness and inexperience" of these firms which could be liabilities for their growth (Heimonen, 2012, Davidsson and Delmar, 1997, Wright et al., 2007). To achieve optimum growth, the firms needs to have a clear plan and due importance should be given to those factors which can help to achieve better performance, thereby fuelling growth.

Storey (1994b) indentified characteristics of the entrepreneur, characteristics of the organisation and types of strategy that are associated with growth as three key components of the small firm's growth. It was further described strategy and management characteristics associated with growth are related to product and markets, production processes and employment and the use of labour.

Over time, there are many research works which have established market share, employment growth, increase in assets, financial turnover and return on investment as key indicators of growth (Adams et al., 2006, Singh et al., 2010, Dobbs and Hamilton, 2007). Based on previous work, the following measurements were adopted in this study to measure the growth of the high-technology firms.

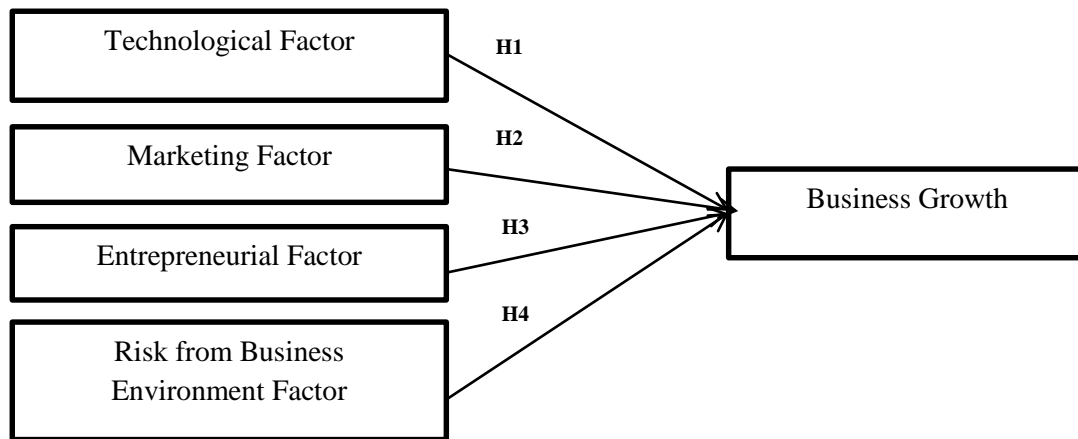
The risk from business growth factor was measured by the following statements:

BG.1	We have expanded our market share consistently in the last five years.	(Singh et al., 2010, Adams et al., 2008a)
BG.2	There is a constant increase in the number of employees of the organisation in the past five years.	(Dobbs and Hamilton, 2007)
BG.3	We have increased our assets constantly in the last five years.	(Barringer and Jones, 2004, Adams et al., 2008a)
BG.4	There is a constant increase in the return on our investment in the last five years.	(Singh et al., 2010)
BG.5	We are confident of doubling our turnover in the next five to ten years.	(Dobbs and Hamilton, 2007)

## 2.9. Theoretical Framework

As discussed, this study has developed four hypotheses and a theoretical framework which explains the relationship between innovation strategy factors and business growth. Based on the literature review, this research work proposes the following four positive hypotheses, as modelled in Figure 2.11:

1. Technological factors have a positive influence on business growth.
2. Marketing factors have a positive influence on business growth.
3. Entrepreneurial factors have a positive influence on business growth.
4. Risk or business environment factors have a positive influence on business growth.



**Figure 2.11: The theoretical framework to determine the relationship between innovation strategy and business growth**

The theoretical framework summarises the innovation strategy factors that this study has proposed as the influencing factors that can positively affect the business growth of a high-technology SME. The Technological factor and Entrepreneurial factor represents the resource-based view of this study whereas Marketing factor and Risk from Business Environment Factor represent the dynamic capability theory view. As discussed in the literature review, it is the resources and the dynamic capabilities which play an important role in developing the crucial capabilities needed for better performance of the innovation strategy which will positively affect the business growth of the firm. This framework is empirically tested to confirm the proposed hypothesis.

## 2.10. Conclusion

In this chapter, existing literature on innovation, innovation strategy and business growth has been reviewed. Innovation management is an essential activity which has a positive influence on business growth of the firm. A high-technology SME needs to continually innovate to have sustainable growth and to have a sustainable new product development or new services, a firm needs to adopt an innovation strategy which will help the firm to appropriately allocate the limited resources. An innovation strategy can also help to develop dynamic capabilities in order to be competitive in the rapidly changing external environment. Four factors were considered as important part of an innovation strategy and four hypotheses were proposed based on the theoretical model developed through literature review. The next chapter discusses the research methodology adopted by this research study and the reasoning for the same.

## CHAPTER 3: RESEARCH METHODOLOGY

### 3.1. Introduction

A theoretical framework representing the relationship between innovation strategy factors and business growth was developed, discussed and presented in the previous chapter. This chapter discusses the research methodology path used by this study and presents an overview of research philosophy paradigms and research approaches. The research paradigm determines the selected path of the research to test the hypotheses formed after an in-depth literature review. This chapter discusses the research philosophies and paradigm, research approach, research strategy, research method, reliability and validity of the data collection instrument that enable the testing of the hypotheses. The chapter gives a clear picture of the process followed to collect the data, discussing sample selection procedures, sample size, questionnaire development, response rate, and data analysis tools and statistical methods used to analyse the data obtained through the survey method. The structure of the chapter is as follows:

- Research philosophies and paradigm
- Research approach
- Research strategy
- Research method
- Reliability and validity
- Ethical consideration and Data collection
- Conclusion.

Various approaches to management research have emerged, which have tried to establish appropriate paths to carry out research for better understanding of society, as well as various aspects related to it for the betterment of society. As noted by Collis and Hussey (2008), there are three established research processes – quantitative, qualitative and mixed-methods. These three processes have different research paradigms, strategies and designs, methods and tools to collect empirical evidence. Quantitative research is concerned with measurement of the phenomenon being investigated, whereas qualitative research is concerned with the qualities of the phenomenon. The mixed-method approach combines both quantitative and qualitative approaches to the phenomenon in one study,



which will be mainly guided by the dominant approach, justifying the research (Morgan and Smircich, 1980). The choices made at various levels in the research process are linked with each other with the research problem, philosophical assumptions, research design and strategy, data collection method and tool, data analysis method and its interpretation. The unit of analysis, targeted participants and the past experiences of the researcher also play an important role in determining the overall research methodology (Saunders et al., 2012, Creswell, 2009).

There are seven sections in this chapter. Section 3.2 presents the discussion on research philosophy and paradigm. Philosophical assumption made regarding epistemology, ontology and the axiological concerns are the foundations methodological approaches take for this research study. The section also presents the rationale for selecting the positivist paradigm for this research study. A section 3.3 and 3.4 discusses the research approaches and research strategy of the study, respectively. Section 3.5 presents the research design, data collection method and tool. It discusses the empirical survey in detail, questionnaire design and pre-testing of the questionnaire. 3.6 present the research ethics, data collection .process and the selection of statistical techniques for the data analysis. The methodology chapter is summarised in section 3.7.

## 3.2. Research Philosophies and Paradigms

Strategy, research, design and method are guided by the research philosophy. The term research philosophy is related to the nature of the knowledge and its development (Saunders et al., 2012). A research study needs to consider various issues related to ontology, epistemology and axiology. These research issues define perceptions, various beliefs, assumptions, nature of reality and the true knowledge about this reality, and the values of the individuals involved in the research and its influence on the study undertaken from research design to its conclusion. Therefore, it is very important to have a clear understanding of these concepts and adopt an appropriate philosophy and paradigm which is congruent with the aim and objectives of the study, and the nature of the research subject. This informed research path exposes the research to research biases and helps to understand and minimise these biases (Bryman and Bell, 2007)

Every researcher has inherent preferences based on beliefs and values that are likely to influence research designs; thus, an informed choice should be made in following the

appropriate research methodology and all the choices made should align and connect with the research problem. Lack of coherence and incompatibility between research design and the core research problem of the study will lead to inconsistency in the research outcome and actual reality (Bryman and Bell, 2007).

According to Collis and Hussey (2008), the aspects of philosophy and paradigm are very significant in social science research study, as humanistic elements add many components which are complex in nature, such as “free will” of both researcher and participants. They also point to the fact that studying organisational phenomena through various paradigms by researchers will lead to establishing the knowledge from three different philosophical perspectives, which can stimulate debate among academics on the research subject.

Philosophies of research help the researcher to understand the relationship between theory and data, about which there has been a long-standing debate between philosophers and methodologists. Philosophical issues are vital for the quality of research and give clarity to the research design. Philosophers of natural sciences and social sciences traditionally follow contrasting views, namely positivism and social constructionism/ phenomenology. However, there are researchers who have tried to adopt a pragmatic view by drawing methods from both traditions and deliberately combining them (Smith, 1991). A paradigm can be interpreted as a philosophical position which has emerged through an interaction of beliefs shared among various research disciplines to establish a framework, which sets a benchmark for researchers in selecting appropriate methods and tools to carry out the research (Ponterotto, 2005).

Research is about developing knowledge, and research philosophy relates to the nature of that knowledge and the assumptions a researcher makes about that knowledge. The philosophical commitments of the researcher will influence the research strategy and the method the researcher chooses to understand and investigate existing knowledge.

According to Bryman (1988) research paradigm is “a cluster of beliefs in a particular discipline influences what should be studied, how research should be done and how results should be interpreted”. It is a guiding philosophical framework for the scientific research to be carried out (Saunders et al., 2012) There are two main paradigms adopted in social science research, namely positivist and phenomenologist/ interpretivist, which are based on different ontological and epistemological philosophies. There are other paradigms,

namely realism, objectivism, existentialism, critical realism and constructionism (Saunders et al., 2012, Bryman, 2012). However, Collis and Hussey (2008) argue, these paradigms which are based on various philosophical assumptions, are linked to both positivism and interpretivism on either side of a “continuum line”.

A brief discussion about research philosophies is followed by a discussion on paradigms in each of the philosophical beliefs.

### 3.2.1. Ontological concerns

These are the “philosophical assumptions about the nature of reality” Smith (1991). Representation, relativism and nominalism are the three main ontological positions. The first two relate to the point of view of the internal realist, whereas nominalists believe in labelling of the events and experiences. Another position a relativist takes is “critical realism”. It derives from both the extreme positions and tries to recognise the effect of social conditions, even if they are not observed or labelled by the researcher (Smith, 1991).

Saunders et al. (2012) categorised ontological philosophy into two aspects: objectivism and subjectivism. Objectivism interprets the observed world as an independent fact, without any human factor involved, whereas subjectivism takes into consideration these factors and believes the observed world is a consequence of interaction among many social actors.

### 3.2.2. Epistemological concerns

An epistemological position is “concern[ed] with the questions of what is (or should be) regarded as acceptable knowledge in a discipline” (Bryman, 2012) . It is about the relationship between research and knowledge. There are two distinct positions taken in epistemological concerns: positivist epistemology and interpretive epistemology (Bryman, 2012, Hussey and Hussey, 1997).

The positivist calls for an objective method to test or measure any phenomenon. It advocates the natural science method to understand and study social reality. The researcher distances himself from the object of study. The researcher bases his study on a theoretical framework, and a systematic approach is followed to interpret all the factors involved.

Here, the inquiry is objective, leading to the findings, which are true and will show the cause-effect relationship. It is of the opinion that an accepted theory will be tested right all the time, even when it is tested by different empirical measures (Bryman, 2012, Saunders et al., 2009, Johnson and Duberley, 2000).

### 3.2.3. Axiological concerns

Axiological concerns are philosophical considerations which deal with questions of personal values and ethics. According to Saunders et al. (2012), to a certain degree personal values play an important role in our decisions and actions in the research process. The researcher's axiological skills are demonstrated when they articulate their values as the base for the various decisions they take in the research process, from selecting the research topic to the approach they adopt while collecting the data. A statement of values might help both the researcher as well as all the stakeholders. These value judgements also influence the conclusions drawn from the data.

However, the positivist approach asserts, research is undertaken in a value-free environment and data collected is independent of the researcher's personal values and is objective. On the contrary, the interpretivist approach to axiological concerns is, research is not value-free and objective. The researcher is an integral part of the research, hence it is subjective.

In social sciences, positivism and interpretivism are considered the main philosophical approaches. Table 3.1 illustrates the differences between these two philosophical approaches.

**Table 3.1: Philosophical differences between positivist and interpretivist approaches**

<b>Philosophical Assumption</b>	<b>Positivism</b>	<b>Interpretivism</b>
<b>Ontology</b> (Researcher's view of the nature of reality)	The reality is external, objective and is not dependent on any social actions. It is independent of the researcher.	The reality is intrinsic, subjective and is dependent on social actions and socially constructed. It is multiple in nature and may change. It may be perceived differently by researchers.
<b>Epistemology</b> (Researcher's view on what constitutes valid and acceptable knowledge)	Phenomena that are observable can provide credible data and facts. The researcher is independent of the phenomena or the participants being researched.  The research subject is reduced to causality and law, like phenomena.	Research phenomena can be subjective and socially motivated. The researcher interacts with the phenomena or the participants being researched. The research focuses on the details of the situations and subjective reality and motives behind the situations and social actions.
<b>Axiology</b> (Researcher's view on role of value in research)	The researcher is unbiased and the research is carried out in a value-free environment.	The researcher acknowledges their personal values and beliefs. The researcher is subjective and the researcher is an integral part of the research process. The research is value-bound.
<b>Methodological Approach</b> (Research process)	Deductive approach. Research is context-free.  Generalisation leads to prediction, explanation and understanding.	Inductive approach. Research is context-bound.  Patterns and/or theories are developed for understanding.

Source: Saunders (2012)

### 3.2.4. Positivism versus Interpretivism

As discussed, most social science research is based on the positivist and interpretivist philosophical approaches. The philosophy of the positivist research paradigm is based on the ontological concerns and social reality is researched objectively. Positivism also involves certain other principles. As noted by Bryman (2012) the “purpose of theory is to generate the hypotheses that can be tested and that will thereby allow explanations of laws to be assessed”, which reflects the principles of deductivism. The other point of view is

that “knowledge is arrived through the gathering of facts that provide the basis for law” which reflects the principle of inductivism.

The interpretivists, on the other hand, have a contrasting point of view to that of the positivists. According to Collis and Hussey (2008), the emergence of interpretivism is a response to address the perceived inadequacies in the positivist philosophical approach felt by social scientists. They are of the opinion that any subject related to human beings and their institutions fundamentally differs from the subjects of the natural sciences. Hence, the social world needs to be studied with a logical procedure which reflects the distinctiveness of the social sciences as against the natural sciences. In social science, it is important to have an interpretive understanding of positive social action to understand the “causal explanation of its course and effects” (Bryman, 2012).

The philosophical thought process of management research has evolved over the past few decades and there is more diversification, which has also led to considerable criticism on the positivist mainstream. The attack has mainly been on “the positivist philosophical commitment, that it is possible to objectively, or neutrally, observe the social world and thereby gather ‘positively given’ data in order to test theoretical predictions”(Gill and Johnson, 2010). The critics are of the opinion that “in observing the world we inevitably influence what we see” . Any researcher whose philosophical approach is positivist should make sure that the external influence at every step of data gathering process is kept to the minimum by creating an effective strategy to deal with the issue.

There is an ongoing debate about the appropriateness of using the positivist approach in the study of social science. It is criticised for having an objective view on every single reality and considering everything that can be observed as real (Sarantakos, 2005, Fraser, 2014). Critics are of the opinion that not everything can be sensed and reality is embedded in human thought and perception, which is internal. The realism of the positivist is called “naïve realism” by critics as it assumes the social world can be defined accurately and casually explained from external observation (Guba and Lincoln, 1994).

However, defenders of positivism suggest it would be a mistake to consider positivism as synonymous with natural science (Bryman, 2012). Here, the behaviours and not the individual are important and these behaviours can be summarised into generalised law.

Such a study is highly structured and has a theoretical base. It uses empirical validation and employs statistical analyses to confirm this theoretical base e.

Table 3.2 gives the overview of the two paradigms and their similarities and differences at various levels.

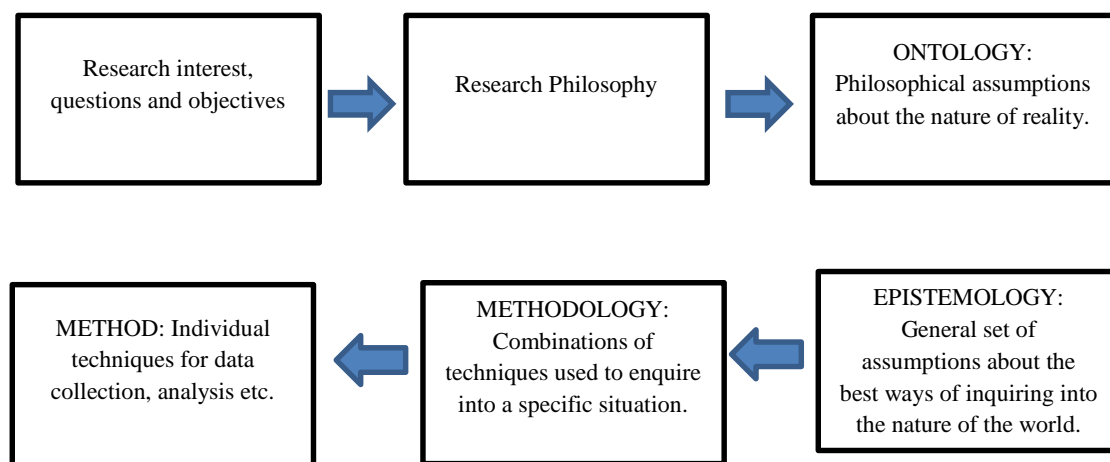
**Table 3.2: Overview of the Positivist and Interpretivist Paradigms**

Positivist paradigm	Interpretivist paradigm
<b>Common terms</b>	
Mainstream	Alternative
Quantitative	Qualitative
Objectivist	Subjectivist
Scientific	Humanistic
Experimentalist	Constructivist
Traditionalist	Nominalist
<b>Main features</b>	
Tends to produce quantitative data	Tends to produce qualitative data
Uses large samples	Uses small samples
Concerned with hypothesis testing	Concerned with generating theories
Data is highly specific and precise	Data is rich and subjective
The location is artificial	The location is natural
Reliability is high	Reliability is low
Validity is low	Validity is high
Generalises from sample to population	Generalises from one setting to another
<b>Methodologies</b>	
Cross-sectional studies	Action research
Longitudinal studies	Ethnography
Surveys	Feminist perspective
Database analysis	Grounded theory
Meta-data analysis	Hermeneutics
	Participative enquiry

Source: Adapted from Fraser (2014)

### 3.2.5. Research Philosophical Design

Research philosophical designs are important to ensure the research process of the study is well structured which will help to maintain the research quality. The proposed philosophical design should be clearly stated and are checked against the research questions of the study to confirm they the research questions will be answered and objectives will be achieved (Easterby-Smith., 2008). As there are various perspective to the way we understand and view human behaviours, these views can influence our understanding of other objects and behaviours. This also applied to the researcher's choice of methodologies to carry out the research. Therefore it is very important to understand and experience various research methodologies which will help the researcher to design the research study. Easterby- Smith.(2008) The philosophical design framework (Figure 3.1) presents the process of research design. A philosophical design covering ontology, epistemology, methodology and methods are an important guidelines of a research study.



**Figure 3.1: The framework of philosophical design**

Source: Easterby-Smith et al. (2008)

To carry out this research on innovation strategy, a set of philosophical approaches were drawn which are preseted in Table 3.3. The rationale behind adopting these perspective or methods is expalned in the following sections.



**Table 3.3: Research Focus of the study**

Ontology	Objective
Epistemology	Positivist
Methodology and Theory Building	Hypothetico-Deductive
Techniques	Statistical Testing
Research Design	Empirical - Survey Research
Data Collection Method	Questionnaires
Research Design	Implementation; Analyse Data; Reporting Finding

### 3.2.6. Rationale for adopting the positivist paradigm

This study adopts an objective ontological paradigm. By adopting an objectivist approach, the researcher can look at the study without any biases and not allowing his/her beliefs, values, and interests to interfere. This is very important to answer the research questions of this study, which seeks for an objective evaluation of the relationship between innovation strategy and business growth of a high-technology firm.

After the review of paradigms like positivism, post-positivism, constructivism, and interpretivism, a positivist approach is considered as the appropriate epistemology to investigate the relationship between innovation strategy and business growth in high-technology SMEs. This study aims to understand the implications of having an innovation strategy on the business growth of a firm. It is also wants to understand how resources and dynamic capabilities of a high-technology SME can support better performance of the firm. This involves the researcher looking at the relationship between two factors which are derived from the existing theory.

This research is grounded in the positivist philosophical paradigm as the researcher is independent of the proposed unit of analysis, high-tech SMEs; the human aspects are largely irrelevant as the literature largely provides factors which have been generated based on the resource-based view of the firm as opposed to the capability-based view which may have presented methodological complexity. Further, hypotheses and the unit of analysis can be clearly defined and access to data means that random selection of an appropriate data set is possible. Here, the researcher is observing the phenomenon as an outsider for credible data and facts. Hypothesis are formed based on the existing literature and are being tested from the data collected from the unit of analysis of this study.

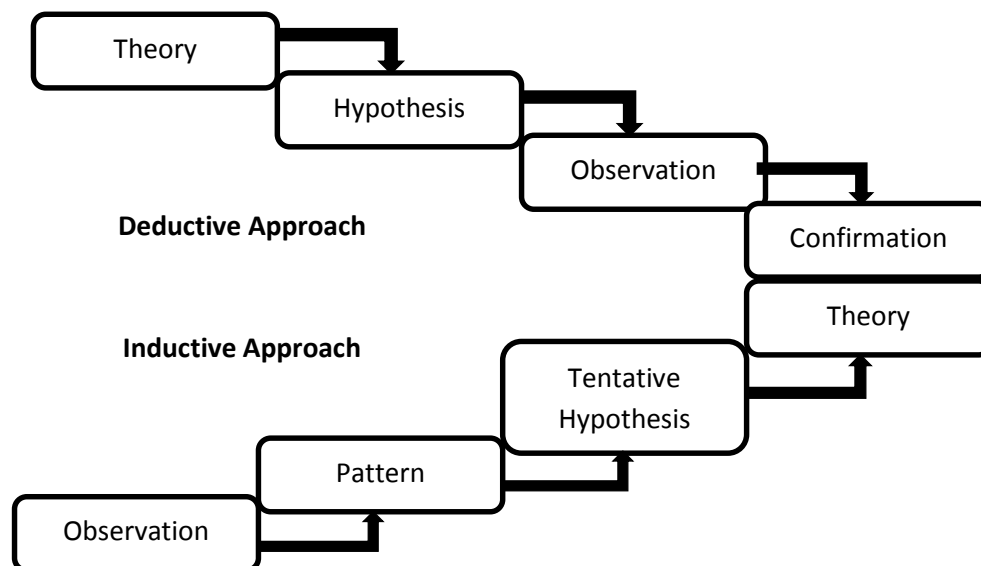
The aim of this study is to understand the role of innovation strategy in the business growth of an SME. Here, reality is being investigated, through an objective investigation of the behaviour of the social and institutional actors and is independent of social actors and institutions. This study has a theoretical framework which is based on previous studies and it is being tested using statistical methods. The theory is tested through hypotheses, which are developed based on the literature review and theoretical framework. According to Plack (2005), the positivist paradigm favours validated and reliable methods to study the phenomenon in a relatively objective way; hence, the positivist paradigm is an appropriate philosophical approach for this study. Table 3.4 shows the how the positivist philosophical paradigm is used in this study.

**Table 3.4: Positivist philosophical paradigm of the study**

<b>Basic Principles</b>	<b>Positivism</b>	<b>Study Design</b>
View of the world	External and objective	There is an intense competition among high-technology SMEs. The success of their innovation can be influenced by many factors both internal and external. The resources, capabilities, market volatility, customers, competitors, suppliers, government etc. can influence the success of an innovation strategy as well as the performance of the firm. This phenomenon is external and needs to be studied objectively.
Researcher's involvement	Independent	Existing literature is used to propose a conceptual framework and hypothesis. Hypothesis to be tested to confirm the proposed hypothesis.
Influence of the researcher	No interference of researcher's value and beliefs	The data is collected from a large population of high-technology SMEs in the UK. A simple random sampling method is used. Recommended statistical methods were used to interpret collected data to avoid any researcher's biases.
Observed phenomenon	Facts observed objectively	Innovation strategy, business growth, Resources and capabilities (technological factors, marketing factors, entrepreneurial factors and risk from business environment).
Research concepts	Clearly defined and measurable	Innovation strategy, Resource-based view, dynamic capability, business growth.
Unit of analysis	Should be the smallest unit and reduced to simplest form	High-technology SME – Firm level study.
Generalisation of the results	Through Statistical probability	Questionnaire survey method is used. Theory and hypothesis were tested by the data which are subjected to validity and reliability tests.

### 3.3. Research Approach

A research work will involve the use of theory and it will be explicitly presented with the findings of the research and conclusion. However, the extent to which there is clarity about the theory before collecting the data determines the approach taken to collect the data and its research design. There are three research approaches based on the reasoning adopted by the researcher: the first two are the deductive theory approach and the inductive theory approach. A third approach has also emerged in recent years, which is called the abductive theory approach (Saunders et al., 2012). A “top-down” research approach is followed by a deductive approach whereas “bottom-up” research is followed by an inductive approach (see Figure 3.2).



**Figure 3.2: Research process in inductive and deductive approaches**

Source: Trochim (2006)

#### 3.3.1. Deductive approach

The deductive theory approach is followed when the researcher looks into the existing knowledge and theoretical consideration in a particular domain, and deduces a hypothesis/ hypotheses which will be scrutinized with empirical data (Bryman, 2012). A deductive process follows a logical and structured linear sequence and is about testing an existing

theory. A conceptual/ theoretical framework is developed and tested with empirical observation, which leads to confirming the existing knowledge or modifying it, if there is strong empirical data to support this change (Collis and Hussey, 2008). In this approach, quantitative data are collected and it follows a structured research process for validating the research outcome (Saunders et al., 2012).

### 3.3.2. Inductive approach

The inductive theory approach follows an opposite path and tries to build a theory from the empirical data collected. Here, the researcher tries to generalise the theory from specific empirical data as against the deductive approach where theoretical analysis goes from general to specific (Saunders et al., 2012). The research process begins with specific observation, collecting the data, finding a pattern through analysing the data and finally proposing the theory (Smith, 1991, Saunders et al., 2012). This approach strives to gain deeper insight into the subject of the research and look into multiple implications of an event. Here, qualitative data is collected and a more flexible research process is followed. The inductive approach is less concerned with generalisation of the research outcome (Saunders et al., 2012).

### 3.3.3. Approach chosen

Every approach has its own advantages and disadvantages. Given that the researcher has been able to develop hypotheses from the existing literature and a positivistic approach is possible, a deductive approach is used here, i.e. theory will be tested. Four hypotheses are developed from existing literature on innovation strategy, based on the resource-based view and competitive advantage theory. These hypotheses are tested through quantitative data collected through a survey questionnaire.

## 3.4. Research Strategy

An important part of the research process is to make a precise plan to collect appropriate data which will answer the research questions. The research strategy should clearly state how a researcher intends to collect the data, the methods and tools proposed to collect the data, and this must be consistent with the research philosophy, paradigm and research approach adopted by the researcher (Saunders et al., 2012).

Business and management research studies have adopted various research strategies such as: grounded theory, experiment, ethnography, case study, survey, action research and longitudinal studies. Some strategies, such as the survey and experiment, are associated with positivism and the deductive research approach, while ethnography and grounded theory are associated with interpretivism and an inductive approach. However, some of these strategies can correspond to both philosophical paradigms to a certain extent, such as a case study (Collis and Hussey, 2008).

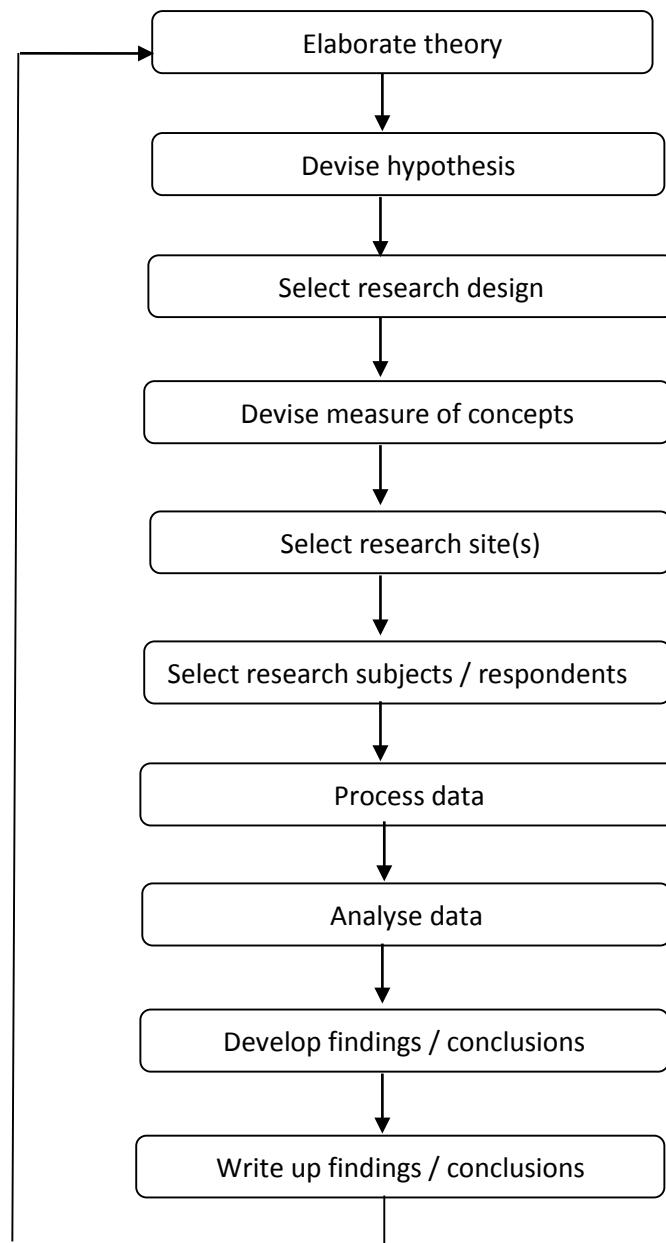
A research strategy should be designed based on the aim and objectives of the study and choosing most appropriate methods and tools. There are two main research methods which are widely used, quantitative and qualitative methods. Mixed-method or multiple-method is also used, which uses the elements of both quantitative and qualitative methods. Quantitative research strategy “emphasizes quantification in the collection and analysis of data”, whereas qualitative research strategy “emphasizes words rather than quantification in the collection and analysis of data” (Bryman and Bell, 2007).

Quantitative research views social reality as external to objective reality and , follows the deductive approach and incorporates positivism to test the theories, whereas qualitative research views “social reality as a constantly shifting emergent property of individuals’ creation”, follows the inductive approach and interpretivism (Bryman and Bell, 2007).

In line with the positivistic and deductive approach chosen for this study, quantitative data analysis methods are appropriate to achieve the set objectives of this research and answer the research questions. Similar studies in business and management research have used a survey method, which is one of the widely used quantitative methods (Bryman and Bell, 2007). Interviews and questionnaires are commonly used data collection techniques in survey methods. This study adopts a survey questionnaire tool to collect the data from high-tech SMEs to test the hypothesis developed in this study and to validate the findings.

#### 3.4.1. Research design

Research design is the detailed plan before the actual implementation of the research work. Figure 3.3 shows a systematic approach to quantitative research.



**Figure 3.3: Social research methods (Bryman, 2008: 161)**

#### 3.4.2. Study design

As this study is based on previous studies' theoretical approach, research methodology as well as the data collection method was also adopted from previous works. There are previous studies which have used quantitative method and survey questionnaire to collect data on innovation-related studies. Table 3.5 lists some of the previous studies on which this research study is based.

**Table 3.5: Methodology of previous studies**

Study	Method	Tool
Frank, 2004	Quantitative	Survey questionnaire
Verhees and Meulenberg, 2004	Quantitative	Survey questionnaire
Strecker, 2007	Quantitative	Survey questionnaire
Branzei and Vertinsky, 2006	Quantitative	Survey questionnaire
Laforet and Tann, 2006	Quantitative	Survey questionnaire
Morgan and Berthon, 2008	Quantitative	Survey questionnaire
Ujjal, 2008	Quantitative	Survey questionnaire
Poorkavoos, 2013	Quantitative	Survey questionnaire

#### 3.4.3. Survey method

A survey approach falls between ethnography and experimental research, where it takes the logic of a experiment inside the laboratory into the field, to understand and assess the casual relationships between variables (Gill and Johnson, 2010). The form a survey takes should acknowledge its intermediate position and its proximity to the logic of deductive enquiry by their emphasis on reliable data collection and the statistical control of variables in place of the physical controls of the laboratory.

Survey methods are used mainly for two purposes in business and management research studies. The first purpose of the survey is to be able to provide an accurate representation of the phenomena being researched through descriptive surveys, and the second one is to determine the existence of a relationship between variables through analytical surveys. One of the main objectives of this study is to determine the relationship between innovation strategy factors and business growth. Hence, a survey method is an appropriate method for collecting the data.

The survey method is very popular among researchers in business and management research for various reasons. This method is ideal and economical for collecting a large number of data, targeting a large population. It also gives considerable control over cost and time, as the findings could be generalised to the larger population through appropriate sampling techniques.

However, there are some limitations to quantitative methods. The survey method cannot be used to investigate phenomena in great depth. Data collected is self-reported, which might be biased, particularly if the required information is sensitive in nature. The main limitations of quantitative methods include internal validity, external validity, reliability and bias (Saunders et al., 2012). To address these limitations, a systematic process needs to be followed and the questionnaire needs to be designed following the established procedures. It also needs to be tested with the target group for validity and reliability. It is vital that the survey questionnaire is appropriate for the targeted participants of the research and it is measuring what the research study intends to measure. Appropriate selection of the study population and the sample is also very important to collecting the appropriate data. The latter part of this chapter explains in detail how these limitations are addressed in this study.

A survey method is one of the more widely used tools to collect data. The advantage of using a questionnaire is low cost, wider reach to survey participants, anonymity and convenience to the participant. There are a few disadvantages like longer time period in the process of collecting data and continuous follow-ups, low response rate, less control over the situation, and difficulty in collecting detailed and extensive information (Frankfort-Nachmias and Nachmias, 1996).

Survey research is a cross-sectional design, where data are collected mainly using a questionnaire or structured interview (Bryman, 2012). There are three different ways of designing a survey: factual, inferential and exploratory. Factual surveys are predominantly used in marketing research or opinion polls, whereas exploratory surveys are used in strategy or in an organisational psychology field. Inferential surveys are used to “establish the relationship between variables and concepts” (Smith, 1991). The survey proposed here is inferential because the study tests the relationship between innovation strategy factors and business growth.

The major concerns while using survey research are sample size, procedures to be followed while collecting data, data analysis and measurements, which are extensively discussed in various methodology books and journal articles.



Surveys follow not just a deductive method, but can also have an inductive form. An exploratory investigation is conducted without any structured framework to develop a theory, which is an inductive form, which is tested using a structured questionnaire in the main study (Gill and Johnson, 2010).

The approach to the sample used to collect the data is determined by the objectives of the research. The size of the sample and geographical dispersion are the two main areas which determine the way the respondents are contacted.

Two main choices involved in collecting data are sending a questionnaire through post or email or administering it through an interviewer either face-to-face or by telephone (Frey, 1989, Gill and Johnson, 2010).

Administering the questionnaire face-to-face or by telephone was not a viable option as it is time-consuming and is not a cost-effective method, as the respondents are dispersed geographically. Following from the positivist approach taken by this study and also by evaluating the methods used in the previous studies of a similar nature, which are listed in Table 3.4.3 the survey method was found appropriate for collecting data, though the interview method has the advantage of a higher response rate.

Initially the questionnaire was sent by postal mailing. Due to its low response rate, an alternative data collection tool, a web questionnaire, was adopted to collect the data for the study. The response rate proved to be significantly better than postal mailing.

#### 3.4.4. Questionnaire design

Design of the questionnaire plays a very important part in obtaining accurate data and also a better response rate. Numerous rules have been developed over the years related to dos and don'ts while asking a question. Bryman and Bell (2007) have addressed some of the general rules of thumb. It is very important to always look back at research questions while designing questions. One also has to be very clear about what the researcher wants to know from that particular question and also how the researcher himself would answer the question.

Specific rules that the researcher should follow are to avoid ambiguous terms in questions, avoid long questions, avoid double-barrelled questions, avoid very general questions, avoid leading or loaded questions, which might lead the respondent to answer the question in one particular direction, avoid asking two questions in one question and avoid questions that include negatives (Bryman and Bell, 2007).

Presentation of the questionnaire used throughout the process of collecting the data is also very important in increasing the response rate. The length of the questionnaire, the order in which the questions are asked, the number of questions, the way sensitive information questions are designed, user-friendliness, clear instructions, researcher's contact information, professional covering letter on a letter head of the organisation, type of outgoing postage and return envelope, level of personalisation, offer of the results, incentives offered, pre-contacts, follow-ups, anonymity and confidentiality of the respondents and responses are some of the important aspects of presentations (Dillman, 2007).

The questionnaire used for this research has taken into consideration the above-mentioned points from design stage to administration. Cover letters were printed on Business School, University of Bedfordshire, headed letter paper and addressed to individual people. (See appendix B). The covering letter gave a brief background of the study, clearly stated the objectives of the research, importance of their participation and their contribution to knowledge by participating in the survey. It also explained the confidentiality regulations followed, their voluntary participation and incentive given for their participation. All the participants have been offered a free copy of the executive summary report of the research results.

The questionnaire had six pages including a cover page and informed consent form. The research topic was clearly mentioned on the top of the cover page in bold and clear instruction about returning the questionnaire was mentioned at the bottom of the first cover page.

The informed consent form was attached to the questionnaire. It clearly mentioned the purpose of the study, the benefits of the study, confidentiality regulations followed at the University of Bedfordshire and respondent's right to withdraw at any time. Contact

information about the research with email address and phone number was given, for participants to contact if they had any concerns or questions regarding the research and questionnaire.

The questionnaire contained 38 questions. It began by requesting information about the participant and organisation. Before moving into the five main sections, the definition of innovation which has been followed for the purpose of this study was clearly stated. The five sections explored four input factors (technological factor, marketing factor, risk factor, entrepreneurial factor) consisting of 27 independent measurement variables and one output factor (business performance) consisting of 5 dependent variables. The questionnaire ended by thanking the participants and gave them an option to express their interest in receiving the executive report. The same format was followed in designing the web-based questionnaire. Qualtrics, a website, which provides the tools to design the questionnaire as well as to host the questionnaire, was used for administering the web-based questionnaire.

### 3.5. Questionnaire Validity and Reliability

There are many aspects to positivism, and positivists are of the opinion that management research methodology should imitate [natural] scientific research in order to emulate the success achieved by those faculties (Gill and Johnson, 2010) To achieve a quality result, it is important to have a quality instrument to collect the data. This can be achieved by checking the validity and reliability of the instrument being used.

Validity and reliability perform totally different functions in the process of evaluating the concept, though they almost seem to be synonyms (Bryman, 2008). Validity refers to the accuracy of the measurement process, whereas reliability refers to its consistency. Reliability is about getting the same results through the same measuring device from the same respondents under similar conditions. Reliability does not necessarily imply validity, whereas if the measure is valid it will be reliable (Gill and Johnson, 2010: 143).

#### 3.5.1. Validity

Measurement validity is about determining whether various measures selected for measuring the concepts of the study are really measuring it. As stated by Bryman (2012), "Validity refers to the issue of whether an indicator (or set of indicators) that is devised to

gauge a concept really measures that.” The validity of the data collection instrument was ensured by exploring correct language with the unit of analysis through an exploratory study and also by thoroughly piloting the questionnaire with peers, academic seniors and the targeted population of this study.

There are various methods to determine the validity of a construct: face validity, concurrent validity, predictive validity, construct validity, content validity and convergent validity (Bryman, 2012, Saunders et al., 2012, Hardesty and Bearden, 2004). This study dealt with two kinds of validity, which are appropriate for this study: face validity and content validity.

### 3.5.2. Face validity

Face validity is about establishing new measures which are developed by the researcher, i.e. the measures are a reflection of the content of the research concept being studied. This can be established by consulting experts in the field of the study being researched, to determine if the measure being used in the study reflects the concept being measured, in their opinion. This process is based on an expert’s intuitive feeling. The following process was carried out to determine the measure’s face validity, which is based on the guidelines provided by Bryman (2012):

- The measures were selected after carrying out a rigorous literature review and based on their theoretical context in relation to each construct.
- The selected measures were used on the basis of them being tested in the existing literature relevant to this study. Literature on innovation, innovation strategy, entrepreneurial factors, government policies, risks faced by firms and strategic management were used for measurement of innovation strategy. Organisation growth and performance and literature on SMEs were used for measurements of growth construct.
- Face validity was also determined through review of the questionnaire by two academic experts. Appropriate changes were made in terms of having clarity on a few questions by appropriate phrasing and also changes were made in the layout of the questionnaire.

### 3.5.3. Content validity

Content validity is used to ensure the measures represent the overall domain of that particular construct. This is to make sure that literature from the appropriate disciplines of the study which represent the construct are being used to develop these measures. Content validity is ensured by the following steps, which are advocated by Newman et al. (2013):

- A literature review was carried out with rigour and all the aspects of the construct as well as various disciplines were taken into account in adopting each measurement.
- Various interpretations of the constructs were looked into and the one which is appropriate to the study of innovation and innovation strategy was adopted.

In addition to the above steps, to test the validity of the online format of the questionnaire, certain steps were taken. Once the design of the questionnaire was done on Qualtrics, an exact copy was created and this questionnaire was sent to five senior academics and university colleagues. This was to make sure that all the questions were understood appropriately and that the online format was user-friendly. A few changes were made to the online presentation of the questionnaire to make sure it was user-friendly. However, all the questions and their sequence were kept in line with the paper survey questionnaire.

### 3.5.4. Reliability

Reliability is about the “consistency of a measure of a concept” (Bryman, 2012). There are three key factors involved in measuring reliability: stability, internal reliability and inter-observer consistency. Stability is about making sure the measure is stable all the time. This is important because the researcher needs to be confident about the measures used and it should give the same kind of results from the sample of respondents again and again, if it is administered to the same group.

Another key factor in reliability is to make sure there is internal reliability. Internal reliability is about making sure that all the indicators measuring the same factors are related to each other. Internal reliability can be tested by finding the correlation among the various indicators.

Inter-observer consistency is about checking the phenomenon being tested by two or more different observers. This helps to find the consistency of the application of the measurement being used.

#### 3.5.5. Appropriate language

Every researcher should be mindful of the way language is used to construct the questions as well as clarity in the instructions given to answer those questions (Saunders et al., 2003). Appropriate language was used and the definition of the academic terms as well as the constructs' context of use for the purpose of this study was given. Questions were checked for ambiguities during the pilot study as well as expert opinion being sought from senior academics. The questionnaire went through a number of iterations until no further changes were required.

#### 3.5.6. Questionnaire structure

The main data collection tool adopted in this study is a questionnaire which was administered first through the postal mail and later through the online web link. Existing literature, theoretical frameworks, hypotheses, constructs and measures were the main base for the design of the questions. The questionnaire was structured in an appropriate sequence so as to have a clarity and appropriate flow, which can contribute to the maximisation of the response. The various stages of the questionnaire design were: theoretical framework, draft questionnaire, piloting, questionnaire revision, review by experts and refinement.

There are four main parts to the questionnaire: covering letter, general information about the participant and the participating firm, definition of innovation being the first three. Part four consisted of five sections which included the four independent variables – technological factors, marketing factors, entrepreneurial factors, risk appetite/business environment and one dependent variable – business growth.

Part one included a cover letter which addressed the participant and gave a brief about the research study being carried out and how their participation can contribute to the development of knowledge. It also explicitly stated the University regulations with regard to confidentiality of data collected and also the termination of their participation at any

point while answering the questionnaire. The researcher's contact details were given on the cover letter for any clarification needed for the participants at any stage of their participation.

Part two (see Table 3.6) is about the general information about the participant as well as the firm. Apart from the profile of participants and the firm, some of the information asked here were also indicators of the business growth of the firm in terms of the number of employees.

**Table 3.6: Details of the company and the respondent**

0.1	Name of the Company
0.2	Name of the respondent (optional)
0.3	Job title of the respondent
0.4	Year of the company started
0.5	Number of employees at the year the company started
0.6	Number of employees – Current year

Part three (see Table 3.7) is a very important one in terms of setting the boundary around the definition of innovation and giving a clear idea for the participants about what is being considered as innovation for this research study. It clearly stated that the questions of this survey are based on this definition of innovation, which is adopted from the Oslo Manual for measuring innovation (OECD/Eurostat, 2005). There are essentially four types of innovation identified in the Oslo Manual for measuring innovation: product innovation; process innovation; marketing innovation and organisational innovation.

**Table 3.7: Definitions of Innovation**

Product Innovation	This involves a product or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.
Process Innovation	Process innovation involves a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
Marketing Innovation	Marketing innovation involves a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
Organisational Innovation	Organisational innovation involves introducing a new organisational method in the firm's business practices, workplace organisation or external relations.

Source: (OECD/Eurostat, 2005)

Part four has five sections (Tables 3.8 a-e) and they represent the independent and dependent variables. These sections are to measure the main constructs: both dependent and independent variables. Measures were in the form of statements with a five-point Likert scale to measure the response of the participants. The five points on the scale were from “Strongly disagree” to “Strongly agree”, along with “disagree”, “neutral” and “agree” in between. The option of “Does not apply” was given to enable the respondent not to leave the question unanswered in case certain statements do not apply to their firm or do not relate to the context of their innovation. The use of a Likert scale also made it easy for the respondents to answer the questions (Saunders et al., 2003).

**Table 3.8: Part 4 Statements**

**a) Section 1 – Technological Factors**

	Statements
1.1	A majority of our innovations are based on core technology never used in our industry before.
1.2	A majority of our innovations involve technology that makes old technologies obsolete.
1.3	A majority of our innovations use new technologies that permit quantum leaps in performance.
1.4	A majority of our innovations use technologies that have an impact on or cause significant changes in the whole industry.
1.5	A majority of our innovations use technologies which represent minor improvements over previous technologies.



**b) Section 2 – Market Based Capabilities**

	Statements
2.1	The majority of our innovations address completely new customer benefits.
2.2	The majority of our innovations offer customers unique advantage over competitors' products.
2.3	The majority of our innovations require changes in established attitude and behavioural pattern from our customers.
2.4	Our mainstream customers require major learning efforts to use majority of our innovations.
2.5	The majority of our innovations involve high switching costs for our mainstream customers.
2.6	The majority of our innovations are similar to our main competitors' products.
2.7	We have the ability to introduce new products more quickly than our competitors.
2.8	We have the ability to customise products to individual customers' needs.

**c) Section 3 –Entrepreneurial Factors**

	Statements
3.1	The CEO is involved in the product/service development.
3.2	The CEO is committed to building relationships with employees and there is mutual support and trust.
3.3	The CEO has previous experience with product/services development alliances.
3.4	The company makes innovation happen through strong clear vision.
3.5	There is a long term commitment to innovation.
3.6	There is a clear allocation of resources for the implementation of innovation.
3.7	The CEO encourages change and creates the right climate for the implementation of innovation.

**d) Section 4 – Risk Appetite / Business Environment**

	Statements
4.1	The market has been hostile and unpredictable.
4.2	We have constantly sought to introduce new products and services.
4.3	When considering business opportunities we prefer a low risk with moderate return to a high risk opportunity with high return.
4.4	We regularly need to make changes to our business operations because of changes in government policies and regulations in the following areas:
	Tax benefits of the company.
	Government funding for R&D.
	Foreign direct investment regulations and restrictions.
	Import / Export benefits and restrictions.
	Intellectual laws which make companies liable to follow the new standards set by government.
4.5	We actively nurture the relationship with our existing customers.
4.6	We actively monitor our competitors.
4.7	Our competitors have the ability to introduce new products more quickly than us.

**e) Section 5 – Business Growth**

	Statements
5.1	We have expanded our market share consistently in the last five years.
5.2	There is a constant increase in the number of employees of the organisation in the past five years.
5.3	We have increased our assets constantly in the last five years.
5.4	There is a constant increase in the return on our investment in the last five years.
5.5	We are confident of doubling our turn over in the next five to ten years.

### 3.5.7. Survey length

Length of the survey is a factor which plays an important part in response rate. The longer the questionnaire, the more participants will be influenced negatively (Bryman, 2012, Dillman, 2000). Though there is no consensus on what should be the ideal length, there is an agreement that if the questions are shorter, participants will not refuse to take part by just looking at the questionnaire. As the participants are investing their time voluntarily, the researcher should be mindful of the time that they will take to complete the questionnaire. Keeping these academic arguments in mind, the length of the questionnaire was kept short.

### 3.5.8. Pilot study

A pilot study is a trial which is carried out on a small scale prior to the main data collection. The aim of the pilot study is to assess the competence of the research design and the instruments being used for data collection.(Sapsford and Jupp, 1996).Though it may not be possible to cover full representativeness in the small pilot sample, it will cover various people who are the target participants for the main study.

Andrews et al. (2003) proposed four key stages in testing the data collection instrument:

1. Pilot testing among experts and academic colleagues to ensure the quality of the question in terms of relevancy, appropriate format and completeness.
2. Observing the participants while answering the survey questionnaire.
3. Pilot the survey questionnaire in a smaller scale that follows all the procedures that are proposed for the main research study.
4. Final check by a third party for any typos and errors which might have gone unnoticed due to the researcher's over familiarisation with the survey questionnaire.

In confirmation with the rigour needed in the academic research, this study conducted a pilot study. First, the survey questionnaire was distributed among senior academics as well as research colleagues at the university. A few colleagues answered the questionnaire in the presence of the researcher and an in-detail discussion was carried out to understand if there was any difficulty in understanding any question. Input was taken from senior

academics. Necessary changes were made to the questionnaire wherever deemed appropriate. Five high-technology firms were contacted and the survey questionnaire was mailed along with a prepaid envelope. The contact was established before mailing the survey questionnaire. After noting their comments, the final draft of the questionnaire was developed. The final survey questionnaire was checked by a native English speaker to make sure there were no typos.

After an initial low response to the survey questionnaire, administered by mail, it was decided to use an online platform. For this purpose Qualtrics ([www.qualtrics.com](http://www.qualtrics.com)), a web host which supports questionnaire survey was used. The online questionnaire was created on the Qualtrics platform and this was piloted among academics and colleagues to check for its functioning as well as the user-friendliness of the online platform.

#### 3.5.9. Follow-ups

Follow-ups are an effective method to increase the response rate of the participants (Saunders, 2008). However, this process needs to be carried out with sensitivity to make sure it does not infringe on the personal freedom of the targeted participants. Hence, before sending the postal mail, Mail Preference Service (MPS) and Telephone Preference service (TPS) checks were carried out to rule out any targeted participant in those lists. Telephone calls were made to follow up after four days wherever the phone number was available and a follow-up mail was sent after three weeks. The online survey was administered by sending emails, as well as contact through LinkedIn. A follow-up email was sent after a week. This was done on the basis of the advocated average time for an online survey, which is five to six days (Deutskens et al., 2004).

#### 3.5.10. Incentives

Incentives are one of the ways of increasing the response rate. They can be financial or non-financial. The participants were offered a non-financial incentive: an executive summary of the research. At the end of the questionnaire, an option was given to accept the offer or decline. An indication of interest was shown to receive the executive summary from the majority of the participants.

### 3.6. Research Ethics and Data Collection

Research ethics are an integral part of the research process. It is very important to follow all the ethics regulations throughout (Saunders et al., 2003). Participation in the research was voluntary. An informed consent form was attached to the questionnaire. It explained about the study, participation and data confidentiality. It was clearly stated that all the data collected would be secured under the University research and confidentiality regulations. Before sending any mail, data were cleaned for any TPS and MPS exclusion.

#### 3.6.1. High-Technology SMEs

High-technology SMEs are firms with advanced knowledge and capabilities in technology, above-average R&D intensity and an above-average proportion of scientists, professional engineers and technicians in the labour force (Butchart, 1987, Crick and Spence, 2005).

High-technology industries are defined by various parameters. Industry-based researchers have equated high technology with industries that are associated with innovation (Malecki, 1985, Steenhuis and De Bruijn, 2006a), whereas firm-based researchers have equated high technology with small research-based companies (Steenhuis and de Bruijn, 2006b, Bullock, 1983). Previous studies also have categorised high technology on the basis of product and life cycle.

Tether and Storey (1998) define a high-technology industry as an industry which makes an investment in scientific and technological activities that is proportionally more than other industries. The studies on high technologies have used SIC codes for selecting the industries and though this can be proved to be general without any definite boundary line as to the industries that belong to the high-technology category, there is not another better alternative to this method. To minimise any ambiguity, the list of industries which are considered high technology are drawn from previous studies. Hecker (1999) study on labour growth in high-technology industries, which lists 39 industries by US SIC codes, was made the reference point to draw the list of high-technology industries for this study. This list was compared with the government policy documents from the UK's Department for Business Innovation and Skills and Technology Strategy Board and the USA's Bureau of Labour Statistics, which are available in the public domain. Then the UK Standard

Industrial Classification – 2007 was used to list the UK SIC codes for these industries. A total of 154 SIC codes were listed as high-technology sectors (See appendix A).

A European Commission (2005) definition which categorises a firm as SME on the basis of three factors, where there is a ceiling on employee numbers, and turnover or balance sheet, was used to select the firms in the study. Table 3.9 gives the detailed information about the ceiling on these three factors for micro, small and medium firms.

**Table 3.9: Categories of SMEs and their ceilings for three determining factors**

Company Category	Employees	Turnover or Balance Sheet (£1 = €1.2)	
		Turnover	Balance Sheet
Medium-sized	< 250	≤ € 50 M / £41.6 M	≤ € 43 M / £35.83 M
Small	< 50	≤ € 10 M / £8.33 M	≤ € 10 M / £8.3 M
Micro	< 10	≤ € 2 M / £1.6 M	≤ € 2 M / £1.6 M

Source: European Commission (2005)

### 3.6.2. Sample

It is very important to choose a sample for the study to administer the survey questionnaire, as it is next to impossible to reach out to all potential participants. This can be attributed to the limitations of the researcher in terms of time, money and limited access to all the potential participants (Saunders et al., 2003).

To achieve the aim of the research, high-technology SMEs in the UK were selected for this study. The company data were obtained from multiple sources: FAME, Kompass, Worldwide, Onesource, Bedford Council's business data, Technology Strategy Board and LinkedIn. Initially, the FAME database, which covers UK (and Irish) companies with various information, including the SIC codes, mailing address, contact phone number, names of the senior management, turnover of the company, and number of employees of the firm. However, FAME has its limitations and the information available is not totally reliable. Some of the information is not updated appropriately and this led to some of the survey questionnaires returning undelivered. Some of the firms were not in business any longer and some of the people were replaced in some firms. However, the researcher also

used other company databases to cross-check and minimise incorrect data. This limitation negatively impacts the response rate, lowering it.

### 3.6.3. Sample size

Determining the sample size is a very important step in the study design and there are several guidelines and statistical approaches available for calculating the required sample size, which is important to have confidence in the results of the study. It is also important as it is not possible to study the entire population and there are constraints of time and budget (Saunders et al., 2003). According to Bryman (2012), there are mainly two types of sample: probability sample and non-probability sample, which is carried out by selecting the participant companies randomly. The main assumption of this latter technique is that each company will have a chance to be part of the study and this would be a representative sample of the entire population (Bryman, 2012). A random sampling technique was used for the survey of this study and 1,253 companies were sent a survey questionnaire. This was based on Yamane (1967), table presented in Israel (1992), where for size of population of 16,000, with 3% precision and confidence level of 95%, the sample size is 938 (Israel, 1992, Yamane, 1967). With an expected 10% response rate, 125 responses were expected. Though there are various arguments about an acceptable number of responses needed to carry out a factor analysis, a rule of 100 is accepted by many researchers (Hair et al., 2012, Kline, 1998).

### 3.6.4. Data collection and Data Analysis

Data collection and data analysis are the next step which evaluates the framework developed and tests the hypotheses of the study. This study adopted statistical techniques to analyse the variables and their relationships with each other as the study is trying to measure the a concept objectively. The study used univariate analysis and bivariate analysis techniques to test the variables and their relationships. Sample size is one of the main factors which imposes some limitations to the techniques that can be used to carry out the analysis (Bryman, 2012). SPSS software was used to carry out the data cleaning as well as to test the validity and reliability of the data. Multiple regression analysis techniques were selected to carry out evaluation of the theoretical model presented in this

study, as multiple regression is a powerful and flexible method to examine the relationship between quantitative dependent variable and multiple independent variable (Hair, 2010)

### 3.7. Conclusion

This chapter discussed research paradigms in detail and presented the research study design adopted to collect and analyse the data. The next chapter discusses the data analysis. Validity and reliability of the data as well as the research model are tested in that chapter.



## CHAPTER 4: ANALYSIS AND RESULTS

The chapter aims to present the descriptive and inferential statistics of the data collected through the survey method, using a questionnaire. The design and development of the questionnaire instrument and its administration are discussed first and are followed by descriptive analysis of the unit of analysis and measurements of variables. The procedures followed for data screening by coding and editing are presented. Data is checked for missing data, outliers and normality, and finally analysed using factor analysis to confirm the variables and then the model is tested using multiple regression.

### 4.1. Questionnaire as Data Collection Instrument

In this study, data was collected using the survey method, through postal and online questionnaires. Some of the important concerns related to the survey method using a questionnaire as a data collection instrument are population and sample size, the design of the questionnaire, piloting of the questionnaire, administration of the questionnaire for the main data collection and non-response bias, which are discussed in the following sections.

#### 4.1.1. The population of the study

The population of this research study is high-technology SMEs in the UK. Company details were collected from multiple databases, as explained in detail in section 3.6.2.

#### 4.1.2. Data collection

Data collection is the next step after finalising the target sample and finalising the technique to collect the data. One of the main issues faced by a mail survey is low response rate and this issue has been addressed time and again by research on questionnaire surveys; there are many techniques advocated to increase the response rate (Dillman, 1978). Some of the techniques proposed are incentives (financial and non-financial), a well-written, personalised and informative cover letter, statement about the confidentiality of the response, the design, layout and length of the questionnaire, return postage, and follow-up on the questionnaire by phone, email or letter.

Dillman (1978) also proposed three steps in making the questionnaire visibly attractive, so as not to discourage the targeted sample to participate in the survey. It is important to make

sure the length of the questionnaire is not too long and answering questions is not time-consuming. The researcher needs to make sure the subject of the study and the particular areas that are being investigated create an interest in the participants, and this needs to be done by clearly stating the aims and objectives of the study and also by informing the participants how the outcome of the research they are participating can help improve their businesses or any issues that can be related to them personally. The third step is related to trust factor. It is important to establish trust with the participants, which can be done by following some procedures, like using official headed letter paper, giving the contact details of the researcher and clearly stating participation is voluntary and they can withdraw from participation at any time.

Based on the above proposed points, the cover letter was printed on the Business School headed letter paper, and it addressed the participants by their name and position. The letter clearly stated the aim of the study and its contribution to the growth of the businesses. It also stated about the confidentiality terms and anonymity of the information provided. The researcher's information was provided in the cover letter (See Appendix B). The length of the questionnaire was kept short. The survey questionnaire with a pre-stamped return envelope was sent to 830 Chief Executive Officers and Managing Directors of high-technology SMEs. (Some also went to a few other top management designations such as Director, Founder, Chairman and R&D Director). Four days after sending the letter, calls were made to 150 companies which were selected randomly. There were very few positive responses for the calls. Some of the calls were answered by the receptionists and it was difficult to get through to the head of the company who were the target participant. Some of the calls were answered negatively and they politely refused to participate in the survey. Some companies were no longer in the business or their status of SME was changed. The follow-up letter was sent after three weeks to the targeted sample from whom there was no response.

A total of 69 postal survey questionnaires (8.36%) were returned, of which 21 questionnaires were not opened, the reason being "addressee no longer at the address". Another 4 respondents opted out, informing "they are not interested in participating in this research study" and 3 responses were removed from the final number of responses, since they are no longer considered as SMEs, due to an increase in their employee numbers.

After the follow-up mails, as time moved on it became clear there is a need for another approach to be adopted to collect more data. In order to improve the response rate, it was decided to use professional social network LinkedIn and emails, to contact more companies. Hence, an online version of the survey questionnaire was designed. A total of 423 questionnaires were sent through emails.

LinkedIn professional networking platform and the Technology Strategy Board's online networking site \_connect, was used to contact the CEOs of high-technology SMEs. An exhibition and a completion arranged by the Technology Strategy Board was attended by the researcher to establish more contacts. The Technology Strategy Board database was also used to target the sample population and emails were sent with the link to the questionnaire. A follow-up email was sent three days after the initial email. The response rate was better than the mail survey and there were 108 (22%) contacts who visited the questionnaire link.

Data from both online and paper versions were entered into SPSS, after reviewing, cleaning and coding. There were 108 responses from the online version and 41 for the paper version. In total, there were 149 responses which were combined together. Based on the definition of the SMEs this study is following 4 companies employing more than 250 people were removed from the database. Responses with extensive missing data were also removed. In total, from both postal and online questionnaire survey, there were 106 responses. The survey response is summarised in Table 4.1.

**Table 4.1: Summary of responses to the survey questionnaire**

Number of companies contacted – postal	830	
Returned	69	
Unanswered questionnaire: Address invalid	21	
Unanswered questionnaire: Not interested	4	
Removed – No more SMEs	3	
<b>Usable questionnaires</b>	<b>41</b>	<b>41</b>
Number of companies contacted – Online	423	
Number of response registered	108	
Unanswered questionnaires	18	
Extensive data missing	21	
Firms with more than 250 employees	4	
<b>Usable questionnaires</b>	<b>65</b>	<b>65</b>
<b>Total usable questionnaire – Postal and Online</b>		<b>106</b>

## 4.2. Data Entry and Coding

Data entering and coding is the first step in the data analysis. This study collected survey data using two channels: mail survey and online survey. Online data were imported from Qualtrics in an SPSS file format. The survey data were first entered into an Excel sheet. The data from both sources were combined in a SPSS file. It is important to check the records randomly for any errors. This was carried out by checking 15 records from Qualtrics and 10 survey questionnaires against the SPSS data; it was confirmed there was no discrepancy and all the data entered were accurate.

The next step is labelling the variables and assigning measures to each of the variables. Two measurements were used: scale for numeric data and nominal for alphanumeric data.

### 4.2.1. Identical Sample

It is important to know there are no differences in the nature of participating firms of the survey group since the data was collected using two methods. To confirm the identical nature of the sample in both groups, an independent t-test was carried out. Table 4.2 presents the t-test report carried out for two variables, i.e., Employee number at the start of

the firm and Current Employee number of the firm. The t-test establishes there is no significant difference between the firms who participated through the mail or online surveys. There would have been a difference in the two groups, if the p value is less than 0.05. This result allows the two data sets to be combined together for this study.

**Table 4.2: Independent Samples Test for Employee Numbers - Online and Mail surveys**

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Emp No_Start	Equal variances assumed	.103	.749	.096	104	.924	.008	.082	-.154	.169
	Equal variances not assumed			.106	95.273	.916	.008	.074	-.139	.155
Emp No_Current	Equal variances assumed	.009	.923	-1.496	108	.138	-.222	.149	-.517	.072
	Equal variances not assumed			-1.485	68.204	.142	-.222	.150	-.521	.076

### 4.3. Descriptive Analysis

The accuracy of the data entered in SPSS was also checked through examination of the descriptive statistics as well as graphic examination of the data through histograms and boxplots. The descriptive statistics are presented in the following section.

#### 4.3.1. Profile of the respondents and the firms

The respondents of the questionnaire were top management of the firm with various job titles. They were either managing the firms or they were involved with R&D. The job title of the majority of the respondents is Director or Managing Director; there are also some participants heading the research and development department. More than half of the

respondents are directly involved in the decision-making process of the firms. However, 22.6% of respondents the respondents are from R&D department, who also in a decision taking position with regard to product development. Professional profile of the respondents is summarised in Table 4.3.

**Table 4.3: Summary of the job title of the respondents**

<b>Respondents' job title</b>	<b>Frequency</b>	<b>Percentage</b>
Managing Director	23	21.7
Director	31	29.2
Founder	12	11.3
R&D	24	22.6
Chief Executive Officer	12	11.3
Chairman	4	3.8
<b>Total</b>	<b>106</b>	<b>100.0</b>

#### 4.3.2. Firm characteristics

##### *4.3.2.1. Age of the company*

The age of the company plays an important role in the way they operate and respond to changes in the business environment. Age of firm is also an indicator for the growth of the firm as well as the economy. Many studies have shown that there is a link between the age of firm and growth e. It is also found that young and small-sized firms will be more dynamic and grow rapidly whereas older firms grow slowly due to a certain level of maturity they have reached in their business cycle (Wijewardena and Tibbits, 1999, Evans, 1987). Here, the majority of the companies are very young and this shows they have a great potential to grow and contribute to economic growth.

The majority of the respondent firm are young with 19 companies less than 5 years old and 28 companies less than 10 years old. The age of the participating companies is summarised in Table 4.4

**Table 4.4: Summary of the age of the participating company**

Age of the Firm	Frequency	Percentage
3 – 5 Years	19	17.9
6 – 10 Years	28	26.4
11 – 15 Years	21	19.8
16 – 20 Years	8	7.5
21 – 25 Years	5	4.7
25 Years and above	25	23.6
<b>Total</b>	<b>106</b>	<b>100.0</b>

#### *4.3.2.2. Size of the company*

The size of the company is associated with the strength of the company, and it is an important indicator of the firm's growth. (Pagano and Schivardi, 2003). There is a clear indication that at least 50% of the firms have grown over the years in terms of employee numbers.

The size of the participating companies and the growth in their size has been measured by the number of employees employed when the company started and the number of employees currently employed by the company. The majority of the companies participating in this research study were micro firms, who employed less than 10 people at the start of the company. There are no companies which were medium-sized when they started. However, there is an increase in the number of employees in the majority of companies over a period of time. However, the majority of the companies are still micro firms. This aspect is discussed further in the 'Limitations' section of the Conclusion.

Out of 106 firms, 93 of them were micro enterprises when they started off and only 13 of them were small enterprises.

However, currently, 41 of them are in the range of micro firms and 35 of them are small firms. There are 30 medium-sized firms. The employee number of the firms is summaries in Table 4.5.

**Table 4.5: Summary of the employee number in the participating firms**

Number of Employees	At the start of the firm		Current	
	Frequency	Percentage	Frequency	Percentage
1 – 10 (Micro Firm)	93	87.7	41	38.7
11 – 50 (Small Firm)	13	12.3	35	33.0
51 – 250 (Medium-Sized Firm)	0	0	30	28.3
<b>Total</b>	106	100.0	106	100.0

#### 4.4. Data Screening and Preparation

Further data analysis has to be carried out only after a thorough examination of the data entered into SPSS. Data in SPSS examined rigorously, which followed the statistical steps that are set by Field (2005) and Pallant (2007) before carrying out any type of further analysis. Data screening is a process for any errors in data entry, checking for random and non-random missing values, testing for outliers and normality in the data, and preliminary test for some of the statistical assumptions for any further multivariate analysis. Following these steps are crucial as the accuracy of the results of the main analysis is influenced by the accuracy of the data (Saunders et al., 2012). Further, the data were checked multiple times to evaluate the data for accuracy, missing data, normality and reliability.

##### 4.4.1. Missing values

According to Carpenter et al. (2012), missing data “is the data that exist, and the researcher intended to collect but was unable to do so for one reason or the other”. Missing data is a common problem in empirical studies, especially in a quantitative data collection method. A valid datum which is missing on one or more variable and not available for the analysis is called missing data and they are accepted as the part of the research (Hair, 2010). In most social science research missing data is a common occurrence and this can be attributed to several factors, such as unwillingness to answer certain questions to accidentally missing some of the questions. There are also some questions which might not



be applicable to the participant and some participants might have decided not to continue further when they were half-way through the questionnaire (Bryman, 2012).

Some of the participants will not be comfortable answering certain questions. This is particularly relevant to this study as well as unit of analysis, that some may consider certain aspects of the questionnaire commercially confidential. In addition to deliberate avoidance, sometimes they can miss answering the question accidentally. This was addressed in the online version of the survey questionnaire by prompting the participant on each page, if there were any unanswered questions.

Hair et al. (2006) has addressed the issue of missing data in detail and has advocated three steps to deal with it: measuring the level of missing data and reporting it, identifying the type of missing data and selecting the appropriate method for data treatment.

#### 4.4.2. The extent of missing data

The first step in dealing with missing data is to assess the extent of missing data. This is very important as the researcher can determine if any specific method can be used to treat the missing data, without further analysis for missing data patterns. If the data are missing in high proportion, it should be tested for patterns in the missing data before treating it with appropriate procedures.

The data from online data collection platform Qualtrics was imported into a SPSS file and the data from the paper version was added into the file. Though there were 108 visits to the questionnaire link, there were 18 cases which did not have any entry. Another 4 were removed for not confirming with the defined unit of analysis.

The percentages of missing data for each case were calculated by tabulating the data. Using missing value analysis in SPSS, cases with more than 10% of missing values are removed from the database. There were 21 such cases and most of them were found in the data collected through the online version. After removing these cases, there were 106 cases, which were considered as sufficient to carry out further analysis such as factor analysis and multiple regression analysis.

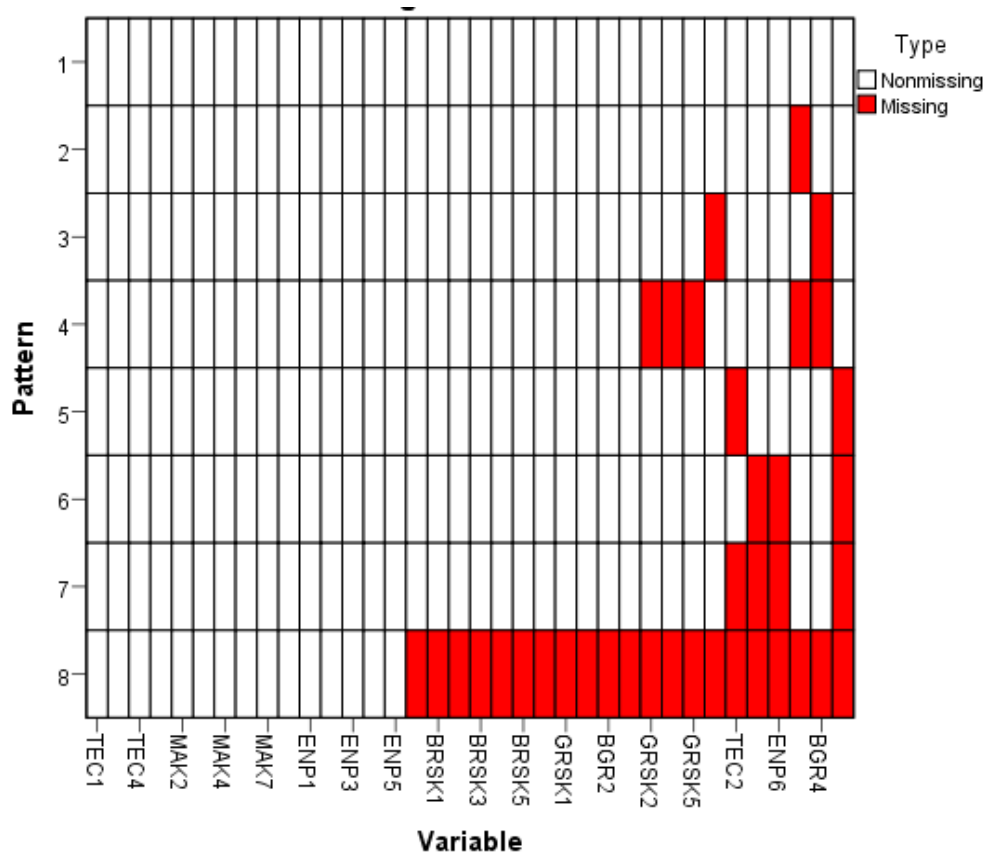
There were some missing data in some of the remaining 106 cases. These cases were not removed from the database as it would further reduce the sample size and also the percentage of missing data can be treated appropriately, which will not affect the final outcome of the results.

The percentages of any missing data in the remaining 106 records were analysed. There were 6.60% cases missing. The measuring scale had the option of “don’t know”. This was treated as missing data and again the data were calculated for missing values. This time there were 37.74% of cases missing.

However, it is very important the researcher address the missing data appropriately as this impacts the results which leads to a biased outcome of the study. To address the issue of missing data, guidelines proposed by Hair et al. (2010) were followed. There were 6.60% values missing, which is within the acceptable range of 5% to 30% as suggested by many scholars (Bryman, 2012, Pallant, 2007). Though the missing value is slightly higher than the accepted range, after treating one of the scale value as missing data, this cannot be considered as biased data as the decision to consider one of the scale value as missing data is taken by the researcher.

#### 4.4.3. Missing data pattern

The next stage of dealing with missing data was to identify the type of missing data. There are three types of missing data: missing completely at random (MCAR), missing at random (MAR) and missing not missing at random (MNAR) (Saunders et al., 2012). The data were tested for patterns in missing values and it was found the data were missing randomly. The visual presentation in Figure 4.1 clearly shows no particular pattern and the missing data were spread across the database randomly.



**Figure 4.1: Missing value patterns**

#### 4.4.4. Missing data treatment

It is important to adopt an appropriate method to treat the data which will reduce the impact of missing data on the results of model of testing using multiple regression technique. The available techniques to treat the missing data are leastwise which is also known as ‘case deletion’, pairwise deletion, single imputation, expectation maximisation and multiple imputation. However, as the data is missing randomly and there is no pattern found, case deletion or pairwise deletion will not be a suitable method to follow. Also, the response rate is limited in this study. Hence it not ideal to lose anymore data by deleting any avaialable data. Hence expectation maximisation (EM) was considered to be an appropriate technique for this study. This is also the most commonly used technique as the test can be carried out easily using SPSS. This technique enables the researcher to maintain the cases and helps to tackle the problem of biased results (Hair, 2010).

In this study, 37.74% data was missing from the data set and box plot visual examination showed the data was missing randomly. This study treated the missing values with EM algorithm, using SPSS 19 data analysis software, which estimated a new parameter that is

most likely to be unbiased value and replaces with the missing value. This method has helped to retain the maximum cases for the analysis without compromising the quality of the data and will improve the statistical power of the analysis.

#### 4.4.5. Outliers and multivariate Normality test

An outlier is generally considered to be a data point that is far outside the norm for a variable or population (Cousineau and Chartier, 2010). Hawkins (1980) described an outlier as an observation that “deviates so much from other observations as to arouse suspicions that it was generated by a different mechanism.” The presence of outliers can lead to inflated error rates and substantial distortions of parameter and statistic estimates when using either parametric or non-parametric. An outlier could be one extreme value found on one variable which is called a univariate outlier, or on a multiple combination of the values on more than one variable which is called a multivariate outlier (Tabachnick and Fidell, 2012).

Outliers are the measurements that do not confirm with the vast majority of the data and they often fall under the two extremes of being much smaller or larger in comparison to the vast majority. These extreme values in the data might lead to non-normal distribution of the data. Outliers can influence the data analysis substantially. A few undetected outliers can change the mean performance or increase variability which will ultimately distort the total outcome of the data analysis (Cousineau and Chartier, 2010).

Depending on the context, they can have a positive or negative impact on the analysis. If the outliers indicate the population’s characteristics, then can be beneficial for the analysis. However, they can completely change the outcome of the data analysis and be problematic, if they are not representative of the population of the study (Hair, 2010).

Based on the source and their uniqueness, outliers are classified into four types: a procedural error, unique in combination, extraordinary observation and extraordinary event. The first type of outlier, a procedural error, is the outcome of a mistake in data coding or an error in data entry. The second type of outlier involves ordinary values that are missing within the normal range on all variables. These values are not extremely high or low, but their combination is unique across variables. These values are usually retained,

unless there is evidence that they degrade the valid relationship with the population. The third type of outlier involves an extraordinary observation for which there is no reasonable explanation. Here, the researcher has to make a judgement on treating these outliers and decide whether to retain or delete these cases and variables. The fourth type of outliers involves an extraordinary event which can explain the uniqueness of these occurrences. The decision to delete or retain these cases or variables has to be taken on the basis of the alignment between the event and the research aims and objectives (Hair, 2010).

In this study, there is no pattern found in the outliers and they are considered the second type. As there are no major deviations found in the missing data pattern, all the 106 cases and variables were retained in the database.

## 4.5. Preliminary Statistical Analysis

Factor analysis was carried out before testing the hypothesis. Factor analysis helps to summarise the variables into a small group and helps to understand the core structure of the relationship among the variables. A group of variables that are highly correlated is called a factor and each of these groups represents a unique dimension based on the data collected. A composite measure can be calculated for each of the dimensions and this can replace the original data which can be used for further multivariate analysis (Hair, 2010).

Based on the literature review, four factors which represent the innovation strategy were developed. Factor analysis was carried out on all the items used in this study to confirm the grouping of these items that are adopted from the literature.

### 4.5.1. Exploratory factor analysis versus confirmatory factor analysis

Factor analysis has two main approaches: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Both approaches have a similar objective of understanding the underlying structure and correlation of variables and presenting the smallest set of variables by reducing the data. However, each follows a different process to achieve their objective: EFA is data-driven, whereas the CFA is theory-driven.

EFA is exploratory in nature and is based on the assumption that each item could be associated with each latent variable. There are no prior assumptions/ restrictions about the number of factors to be extracted. Also, there are very few restrictions for factor loading.

On the other hand, CFA is theory-driven and is based on a factor existing in the theory or on the factors extracted from EFA. This technique is more sophisticated and the variables defined by researcher are tested through the data. Here, the researcher is required to specify the exact number of factors, and also define the underlying structure and pattern of the factor loading. Although both have their strengths, EFA would be more appropriate when the researcher is looking for the underlying structure through the data, whereas CFA would be more appropriate while evaluating the fit between the collected data and the expected structure (Nimtrakoon, 2009).

As this study is testing hypotheses, which are proposed using existing knowledge of theory as well as empirical studies, carrying out CFA is a natural choice of technique to confirm the variables used in each factor. CFA was carried out to test the variables used. However, the CFA test fails to confirm all the variables used in each factor. The main reason for this could be the selection of variables. Though the factors are derived from the literature and all the variables are taken from previous studies, variables in Marketing, Entrepreneurial and Risk factors were taken from more than one study. Hence, it is decided to carry out the EFA test to explore the variables to confirm they are measuring the same factors. The EFA procedure needs to be carried out with some of the prior analytical decisions with reference to the study design, extraction procedure, a number of factors and rotation techniques (Hair et al., 2006).

#### 4.5.2. Principle Component Analysis (PCA) and Factor Analysis (FA)

Both PCA and FA techniques, which are widely used, are based on the nature of the research and the research process followed by the researcher. There are some similarities as well as differences between these two techniques and these should be evaluated against the objectives of the study, before considering an appropriate technique to carry out any further analysis. Both techniques are used for reduction of measured variables into a new set of smaller variables. However, they differ in their specific purpose and the way the variance of the variable is divided (Hair, 2010). If the main aim of the researcher is to test the items' fit and reduce the number of variables into small groups, then PCA is appropriate, whereas FA helps the researcher if they are looking for a better understanding of the underlying correlation structure of the observed variables (Nimtrakoon, 2009).

There is a difference between PCA and FA in the way they use explained variance and unexplained variance in the analysis. As defined by Hair et al. (2006), variance of a variable is “the value representing the total amount of dispersion of values for a single variable about its mean”. There are three categories in the variance of a variable: Unique variance, Common variance and Error variance. A unique variance will have a unique association with a particular single variable and here its correlations with other variable cannot explain the variance. However, common variance in a variable which shares its variance with the rest of the variables that are present in the analysis. Here, correlation of a variable with all the other variables accounts for its variance. Error variance also cannot be explained through the correlations with the rest of the variables. However, the reasons for unexplained variance could be measurement error, error in the data collection process, or a random constituent in the developed measurement (Hair et al., 2006).

During the process of factor derivation, the total variances of all three types are used, whereas in FA common variance is taken into consideration. In FA, unique variance and error variance are assumed to be irrelevant for identifying the underlying structure of the variables. FA tries to understand the structure of the correlation between observed variables through the relationship pattern of common factors and measured variables. In the case of PCA, it takes into consideration all the three variances to calculate the factors, and the underlying structure is not taken into consideration. In PCA results, all the variances are present. Hence, PCA is more of a data reduction method rather than a complete technique for data analysis (Hair, 2010). However, according to Pallant (2007), the term “Factor Analysis” is commonly used, which refers to both techniques by many researchers. This can be attributed to the fact that the results of both PCA and FA tend to be very similar in some circumstances. If there are more than 30 variables or the commonalities of the variables are more than 0.60, both the techniques produce almost similar results (Hair et al., 2006). However, if the communalities are less than 0.40, and measured variables are less than 3 per factor, the results from both techniques tend to be different (Hair et al., 2006). Thus, it is very important to make a distinction between PCA and FA, and PCA should not be referred to as FA. The debate over the superiority of the techniques is an ongoing one, and PCA is considered computationally less complex by its advocates (Nimtrakoon, 2009).

#### 4.5.3. Factor Analysis

Factor analysis (FA) is not a unique and independent technique as there are many different techniques available within the family of factor analytic techniques (Pallant, 2007). Having decided to carry out EFA, the next section elaborates on some important procedures which need to be carried out when using this technique.

#### 4.5.4. Study design

There are two important factors with reference to study design that need to be followed while carrying out EFA. One is with reference to measured variables and another with reference to sample size. Measured variables should be selected after a thorough evaluation and an appropriate number of measured variables is required in the analysis. All the measured variables should be specifically related to the same subject domain and at least three measured variables should be included in one expected factor in the analysis. Lack of adequate and relevant measured variables may produce a false underlying structure. It is also expected that all the variables should be metric variables, as non-metric variables can be problematic (Hair, 2010). This research study is in compliance with EFA requirements as measured variables are specifically related to the factor they are measuring and also there are more than five measured variables measuring each factor. All the measured variables are metric variables. Hence, all the measured variables are believed to be appropriate for EFA.

To confirm the adequacy of sample size, there are two approaches followed by researchers. One is based on the overall sample size and the other on the ratio between cases and the number of variables. As proposed by Hair et al. (2006), a minimum of 50 cases and a preferred sample size of 100 cases is adequate to carry out EFA. With regard to the ratio between cases and the number of variables, 5:1 is the absolute minimum requirement, whereas 10:1 is preferable. This study meets the preferred sample size to carry out EFA.

#### 4.5.5. Factor extraction method:

Factor analysis methods aim for optimal and linear combination of variables measuring the factor. It strives to group the best possible combination of variables which can best explain the total variance in the data as a whole. The factors are extracted in order, and the first factor explains the most variance in the data set and is the best linear combination in structure. A second factor explains the most variance among the remaining variables and is



the second-best linear combination of measured variables. This process continues until all the variance is explained. There will be factors with a smaller number of measured variables as the process continues and a decision has to be made with regard to the number of factors to be retained for further analysis. It is proposed by Fabrigar et al. (1999) to retain only the major factors which are enough to explain the underlying structure of the measured variables and the interrelationships among factors.

The number of factors retained influences the accuracy of FA and therefore both over-extraction as well as under-extraction needs to be avoided, as the final outcome of the results can be adversely affected by these decisions. Very few factors might fail to provide a clear picture of the structure of the model, whereas interpreting the results may become complicated if too many factors are retained (Hair et al., 2006).

There are several criteria to determine the number of factors to be extracted. Some of the criteria which are widely used are: Latent Root Criterion or the Kaiser Criteria, Scree Test Criterion, Percentage of Variance Criterion, Parallel Analysis, A Priori Criterion and Velicer's MAP Criterion. No one technique is perfect and they have their strengths and weakness. To achieve greater confidence in the decision about the number of factors to be extracted, multiple criteria should be employed (Pallant, 2007). In this study, Latent Root Criterion or the Kaiser Criteria and Scree Test Criterion were used to determine the number of factors.

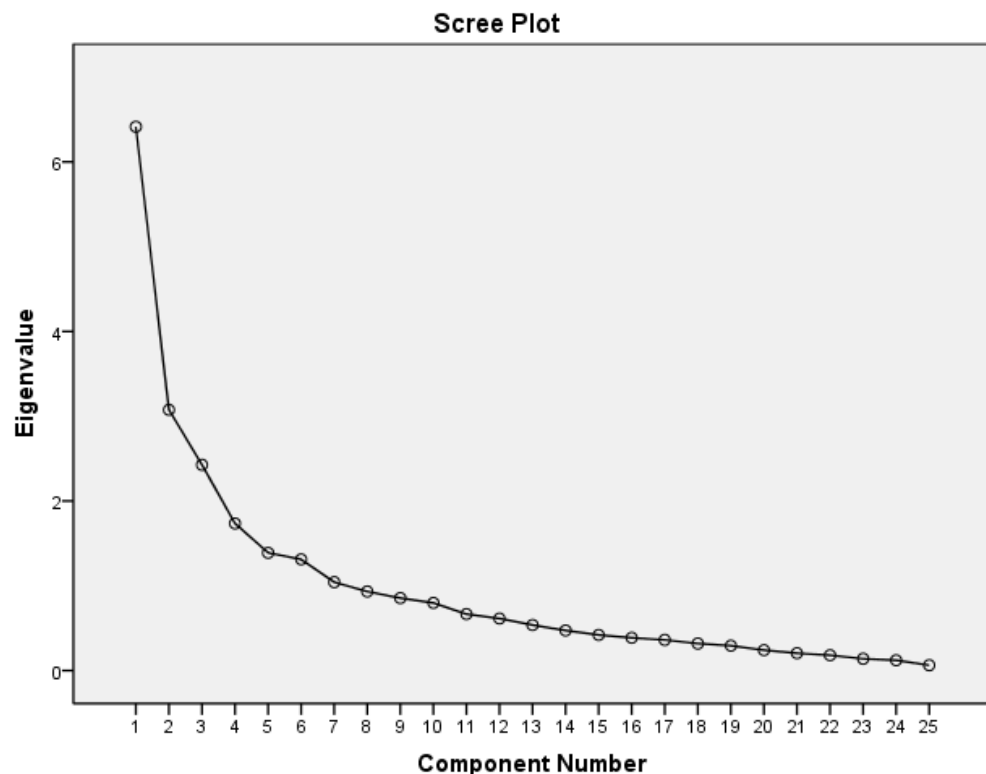
The Kaiser criterion is a widely used technique. This technique retains any factor with at least a single variable and where a value of 1 is contributed to the total eigenvalue. Any factor with an eigenvalue greater than 1 is considered as significant and any factor which does not conform with this value is removed from the analysis (Hair et al., 2006). This strength of this technique is its simplicity and objectivity. However, it is considered as less accurate in determining the number of factors for the analysis. SPSS is used in this study to produce eigenvalues for all the factors.

The scree test criterion produces a graph plotting the number of values on the Y-axis and eigenvalues on the X-axis. The decision on the number of factors to be retained in the analysis is made based on the change in the shape of the line on the graph. The number of factors present on the line before it starts to change its direction and straighten out are

considered for the analysis. This is the point where there will be a considerable drop in the value of eigenvalues (Hair, 2010). The main weakness of this test is its subjectivity in deciding the exact cut-off point on the graph, as there is a level of uncertainty deciding the point at which the line starts straightening out. The scree test can be carried out using many statistical software packages, including SPSS.

Five variables factors were retained for the final analysis, which was decided using both tests. The scree test was used, see Figure 4.2, and the numbers were confirmed by using the Kaiser criterion.

a. Scree Plot: A scree plot generates a graphical representation of variance of each component out of the dataset, which can be retained for further analysis. Visual examination of the scree plot showed 5 points on the graph before it started changing its direction considerably.



**Figure 4.2: Scree test plot**

b. Kaiser-Meyer-Olkin (KMO): which is also called the measure of sampling adequacy (MSA), was tested for overall as well as individual variables. MSA of 0.80 and above is

considered as highly significant; 0.70 and above is considered as middling; 0.60 and above is considered mediocre; anything below 0.50 is considered as unacceptable.(Hair et al., 2006). The MSA for the overall variables was 0.75 and no individual MSA was lower than 0.50. MSA for this study was is an acceptable range. A further statistical test, the Bartlett test of sphericity, was carried out to test the correlations among the variables. A significance value of less than or equal to 0.001 is considered statistically significant. The result of this test showed a statistical significance which determines the appropriate correlations among variables for further analysis. The necessary steps are followed to test the data for factor analysis and factor analysis was carried out on the final data. The results of KMO and Bartlett's tests are presented in Table 4.6.

**Table 4.6: Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity results**

<b>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</b>		<b>0.75</b>
Bartlett's Test of Sphericity	Approx. Chi-Square	1382.98
	Df	300
	<b>Sig.</b>	<b>.000</b>

#### *Bartlett's Test of Sphericity*

The Kaiser criterion test resulted in five factors with eigenvalues greater than 1. The scree test also showed five factors on the graph line before the line started straightening out. The scree test is presented in Figure 4.2.

#### 4.5.6. Rotation of factors and its interpretation

One of the important tools in factor analysis, for interpreting the results is factor rotation. The structure of the factors is simplified and a factor solution which is theoretically more meaningful is provided. Factor rotation helps to reduce the ambiguities in the unrotated factor solution and improves the pattern of the factors (Hair et al., 2006). Here, the factors are aligned with the new axes where the variables are loaded maximally.

Factor rotation can be carried out using two techniques: Orthogonal rotation and Oblique rotation. While rotating the factors, orthogonal rotation retains the independence among the factors whereas oblique rotation permits the factors to relate with each other (Field,

2005). This study used the Orthogonal Varimax technique to determine the independent components and factors (see Table 4.7).

**Table 4.7: Rotated component matrix for Innovation Strategy and Business Growth**

<b>Innovation Strategy</b>	<b>Technology Factor</b>	<b>Risk Factor</b>	<b>Entrepreneurial Factor</b>	<b>Business Growth</b>	<b>Marketing Factor</b>
Tech 4	0.79				
Tech 5	0.75				
Tech 2	0.74				
Tech 1	0.68				
Tech 3	0.67				
GRSK3		0.85			
GRSK5		0.81			
GRSK4		0.78			
GRSK1		0.74			
GRSK2		0.72			
ENP1			0.70		
ENP7			0.74		
ENP4			0.67		
ENP5			0.65		
ENP2			0.63		
ENP3			0.51		
ENP6			0.42		
BGR1				0.83	
BGR4				0.77	
BGR3				0.78	
BGR2				0.78	
BGR5				0.48	
MAK7					0.84
MAK3					0.75
MAK1					0.71
MAK2					0.68
MAK6					0.53
MAK8					0.53

#### 4.5.7. The significance of the factor loading

Initially, in the unrotated factor solution, factors are extracted in the descending order of their variables variances. The largest variance is found in the first factor, followed by factors with less variance. Rotated factor solution was carried out using rotated component matrix, which assess the significance of factor loading. Factor loading is the correlation between a measured variable and its factor and it is used to determine the group of variables

which will fit into a particular factor (Field, 2005). Factor loadings which are greater than  $\pm 0.70$  are considered highly significant and a well-defined structure, whereas factor loadings  $\pm 0.50$  or greater are regarded as practically significant. Factor loadings of between  $\pm 0.30$  and  $\pm 0.40$  are considered as the minimum acceptable level. The next important step after factors are derived through the rotating factor solution, is to interpret the results (Hair, 2010).

#### 4.5.8. EFA for Innovation Strategy

Innovation strategy was assessed by using 32 measured variables which were categorised into technological capabilities, marketing capabilities, entrepreneurial capabilities and business environment capabilities. Table 4.8 lists all the factors used in the questionnaire. The results of EFA and its interpretations are discussed in the following section.

The level of consistency between measurement variables was tested to check the reliability of each factor. Cronbach's alpha, which is the reliability coefficient, was used for each factor to determine its reliability. The Cronbach's alpha of Technology factor, Marketing factor, Entrepreneurial factor and Risk factor and Business growth were obtained respectively, and they are all above 0.70, which is the minimum acceptable limit (Hair et al., 2006).

**Table 4.8: Reliability statistics of each factor**

<b>Factors</b>	<b>Cronbach's Alpha Value standardised</b>
<b>Technology</b>	0.88
Government-related Risk factor	0.87
<b>Business growth</b>	0.83
Entrepreneurial	0.81
Marketing	0.78

The names of the Technology factor, Marketing factor and Entrepreneurial factor were retained as they are. However, the Risk from business environment factor was renamed Government-related Risk factor, based on the measuring variables. None of the items which were related to business-related environment risk were loaded. Two measuring variables were removed from the marketing factor.

The correlation among all the four factors was tested using correlation coefficients and it was found there is some degree of correlation among factors (see Table 4.9).

**Table 4.9: Summary of Correlation Matrix**

Factor	1	2	3	4	5
1	1.000	.190	.128	.255	-.147
2	.190	1.000	-.009	.068	.075
3	.128	-.009	1.000	.106	-.228
4	.255	.068	.106	1.000	-.215
5	-.147	.075	-.228	-.215	1.000

This study has carried out many statistical tests and analysis to establish the logical combination of measured variables and also has identified interrelationships among variables and factors. The new scales were summarised for each factor, replacing the original scale. This new measures is used to carry out the hypothesis testing using multiple regression analysis. Descriptive statistics of the new factors are presented in Table 4.10.

**Table 4.10: Descriptive Statistics for new factors**

	Mean	S.D.
Technology	30.6788	5.04486
Marketing	26.8413	4.16656
Entrepreneurial	29.3453	3.55705
Government-related Risk	13.5474	4.22810
Business Growth	17.4759	3.75255

#### 4.5.9. Multivariate test for assumption

The final stage of examining the data is to test the data for any underlying assumption for statistical tests, through multivariate analysis. This process is the foundation for further data analysis using multivariate techniques, through which statistical inferences are made and final results are drawn. If the data set fails to meet the assumptions, the final results might be biased when multivariate analysis is carried out (Hair et al., 2006).

## 4.6. Multiple Regression Analysis

Multiple regression analysis is a group of statistical techniques which is used to assess the relationship between one dependent variable and more than one independent variable. An independent variable is a predictor whereas a dependent variable is the outcome. Its flexibility is in adapting itself in determining any dependent relationship that the research problem is trying to establish; this technique is widely used in quantitative business and management research (Pallant, 2007).

Multiple regression analysis helps in achieving two main objectives of a research: prediction and explanation. This technique tries to predict the one dependable variable through values from a group of independent variable. It also tries to explain the individual contribution of every single independent variable to the variation of the dependent variable. The regression coefficients can help to understand the magnitude of the relationship between each independent variable and a single dependent variable and the direction of the relationship (positive or negative). It also helps to understand the statistical significance of the independent variables. This helps to develop a theoretical argument which can explain the impact of each independent variable on the single dependent variable (Hair et al, 2006). The multiple regression technique is used in this study to predict and explain the relationship between innovation strategy factors and business growth, and the strength of each factor.

Another important reason for using multiple regression analysis is for its appropriateness when looking for statistical relationships among variables. The data collected in this research involve human perception and opinions. There is a certain level of measurement error, as the variables are measured through approximation and not with an accurate number. As there are issues with confidentiality and it is not possible to get accurate numbers, the survey data have to use approximation to measure the variables. Using multiple regression analysis helps to understand the statistical relationship rather the functional relationship (Hair et al., 2006)

As stated by Hair et al. (2006), a regression coefficient indicates the amount of change caused by the independent variable on the dependent variable. It also helps to assess the type as well as the strength of the relationships between independent and dependent

variables. The sign of the regression coefficient helps to understand whether there is a positive or negative relationship between independent and dependent variables. The magnitude of the regression coefficient shows the degree of change in the dependent variable for each change in every single unit in the independent variable. The independent variable coefficient will be zero when the dependent variable is not affected by the independent variable (Hair, 2010).

#### 4.6.1. Sample size and selection of variables

The research design for multiple regression analysis includes checking for sample size as well as the selection process for variables.

##### *4.6.1.1. Sample size*

Like any other statistical technique, multiple regression analysis is also sensitive to the sample size. It can affect the significance of the results as well as its generalizability. Sample size which is less than 30 cases may be used only for a simple regression, where there is only one independent variable. A sample size which is very large and greater than 1,000 cases may fail to help in understanding the relationship as almost all the relationships can show statistical significance. Hair et al. (2006) proposes a minimum sample size of 50 and a preferable sample size of 100.

Both the coefficient of determination  $R^2$  and the regression coefficient are referred to in the statistical test of multiple regression. Determination of the coefficient is a single measure, which predicts the overall accuracy. The interaction between sample size, the independent variables, and the significance level  $\alpha$  (alpha) in determining the value of  $R^2$  is presented in Table 4.11.



**Table 4.11: Summary of Rsquare value based on sample size**

	Significance of (alpha) = .01				Significance of (alpha) = .05			
	No. of Independent Variables				No. of Independent Variables			
Sample size	2	5	10	20	2	5	10	20
20	45	56	71	NA	39	48	64	NA
50	23	29	36	49	19	23	29	42
100	3	16	20	26	10	12	15	21
250	5	7	8	11	4	5	6	8
500	3	3	4	6	3	4	5	9
1000	1	2	2	3	1	1	2	2

NA = Not Applicable

Source: Hair et al. (2006)

Using the Table 4.11, the significant level of  $R^2$  can be determined. As the sample size of this study is 106, and with four independent variables, at the significance level (alpha) of 0.5, the  $R^2$  value of 12 can be expected for the reliability of the model.

With reference to generalisability of the results, the ratio between sample size and the independent variable is very important. The rule of thumb used in this regard is the ratio of 5:1, i.e., five samples for each single independent variable. The research study will not have any difficulty in generalising the results if the above ratio is present and also there is a good representation of the population in the research sample (Hair et al., 2006). If the sample size is less than the required minimum, there is a danger of the regression model over-fitting the sample size. The results of this study could be generalised, as there are 106 cases and the actual ratio between sample size and the independent variable is 21:1.

#### *4.6.1.2. The selection process*

In multiple regression analysis, as there is a dependent relationship which is influenced by several independent variables, both independent and dependent variables must be clearly specified. Here, the variables are determined based on the previous research work and theoretical rationale. Here, the aim of the study is to determine the influence of the innovation strategy on business growth. Innovation strategy factors are independent variables whose influence on business growth, which is the dependent variable are determined. Both independent and dependent variables are measured using a 5-point Likert

scale. This meets the multiple regression analysis requirement, as all the variables are assumed to be metric variables, as they are measured by Likert scale.

It is very important to make sure that there are minimal errors in the selection of measurement of the dependent variable, as this can have an effect on the accuracy of the results, even with the best possible set of independent variables. The dependent variable measures should be accurate and consistent with the concept being studied (Hair et al., 2006). Though some level of measurement error is expected and acceptable in multivariate techniques, this can be reduced by using a summated scale or multivariate measurements, namely, using more than one measuring variable which represents the concept of the dependent variable. In this study, measurement error is addressed and kept to the minimum by measuring both independent variables and a dependent variable with summated scales. The dependent variable is measured using many indicators of growth such as an increase in sales, turnover, return on investment, and expected growth of profit in the next five years. The independent variables were selected with the theoretical considerations of this study in mind, i.e. RBV and dynamic capabilities theory, and practical consideration, i.e. factors involved in the innovation strategy of a firm.

#### 4.6.2. Assumptions of Multiple Regression Analysis

There will be certain assumptions made with reference to the variables used in most of the statistical tests and the accuracy of the results and their interpretation depends on the degree to which these assumptions are met. In multiple regression analysis, the assumptions are made in four main areas: linearity between independent and dependent variable or the phenomenon measured, constant variance and independence of error terms, multicollinearity and normality in error term distribution.

All the above-mentioned assumptions must be tested, as the concept of correlations depends on the linear relationship between independent and dependent variables. Standard errors can be affected by the unequal distribution of variance among the independent variable. This could lead to an unfair hypothesis testing. In the regression analysis it is assumed that all predicted values are independent and the error term for independence should be checked. The data have to be normally distributed, for the statistical test like  $F$  and  $t$ -test, in regression analysis, therefore the normality assumption test must be carried out. Multicollinearity is the correlation among independent variables if there are three or

more variables. Multicollinearity can affect the regression model considerably, as this can reduce the degree of predictive power of each individual predictor. It can also reverse the regression coefficient's significance. The correlation between the independent variable and the dependent variable is expected to be higher than the correlation between independent variables. However, some level of multicollinearity is accepted in the data collected through a survey questionnaire (Hair, 2010).

Each individual variable was tested for the assumptions in the previous chapter. However, the overall relationship, which is also called variate, need to be examined before testing the hypothesis.

Prediction error in the variate is measured by the residual. The standardised residual which is also connected to  $t$  values is the studentized residual and this is widely used to test for any violation in the assumption of any relationship in the variate. Each type of violation is identified by specific patterns in the residual plots. Heteroscedasticity is represented by the triangle or diamond shape of the plots. Random dispersion or equal distribution of the residuals which show no pattern are expected to meet all the assumptions (Hair, 2010). The scatterplots pattern shows no pattern and almost all meet the assumptions of linearity. Though there are some scatterplots which do not show perfect equal distribution of the plots, they show a small number of outliers which is not alarming. Hence, it is acceptable to assume that the assumptions are met for the further analysis.

There is one more plot which also helps to examine the assumptions of the regression. Partial regression plots are a type of scatterplot which present the residuals of the single independent and the dependent variable, when all other independent variables are controlled. This plot can be used to identify if there are any non-linear relationships and outliers. The partial plots indicate the direction of the linear relationship, i.e., positive or negative relationship, between each independent and dependent variable. This showed a linear relationship between each independent variable and the dependent variable.

The assumptions can be tested at two levels: a univariate test for testing individual variable and a multivariate test for testing all the variables collectively (Hair, 2010)

The skewness and kurtosis technique was used to confirm the assumption for the multivariate normality test. A skewness and kurtosis Z score is considered as normal if the score is within the range of more than -2.58 and less than +2.58 (Tabachnick and Fidell, 2007). The skewness and kurtosis Z score for all the variables was within the range of +/- 2.58 except for entrepreneurial factor 1 and there was no major deviation from normality. This has confirmed the assumption of multivariate normality test.

#### 4.6.3. Linearity test

Testing the relationship among variables is an important step in quantitative data analysis and there are various techniques available to carry out the test based on the kind of data collected. As suggested by Pallant (2011), in survey research, the techniques available to test the “strength of the relationship between the variables” are correlation, partial correlation, multiple regression and factor analysis. In this correlation, there can be only “linear association between variables” and there cannot be any non-linear relationships.

Any non-linear relationship can be identified by a visual inspection for scatter plot matrix. This is very important before carrying out any correlation test. A scatter plot matrix was created to test the linearity test for the variables and it was confirmed there is a linear relationship between variables.

#### 4.6.4. Collinearity test

Collinearity is set of points which measure the coefficients of the variable. As linearity affects the outcome of the research, so does the collinearity and it occurs when there is a strong correlation between independent variables. The collinearity test helps to find whether the variables within the factors are independent. Collinearity can be determined by calculating the variance inflation factor (VIF). Each independent variable was checked against all other variables for collinearity statistics and it was noted that VIF was within the acceptable range, which is below 10 (Hair et al., 2003).

To summarise, assumptions of linearity and collinearity was tested to carry out hypothesis testing using multiple regression analysis. With an exception of small violation, all the assumptions are met.

## 4.7. Hypothesis Testing

This study developed four hypotheses based on the literature review, where business growth is used as a dependent variable. However, though initially the variables were derived from a literature review, factor analysis was used to derive the final variables for the model testing.

The proposed hypotheses are:

- H 1: Technology factors are positively related to business growth.
- H 2: Marketing factors are positively related to business growth.
- H 3: Entrepreneurial factors are positively related to business growth.
- H 4: Government-related risk factors are positively related to business growth.

The results of the regression analysis are presented in Tables 4.12 and 4.13.

**Table 4.12: Multiple regression model summary [IV: Innovation Strategy]**

Dependent Variable	R Square	Adjusted R Square	Standard Error of the Estimate	F Value	Sig.
Business Growth	0.223	0.187	3.41	5.751	.000

**Table 4.13: Multiple Regression coefficients [DV: Business Growth]**

Dependent Variable	Predictors	Unstandardised Coefficients B	Std. Er	Standardised Coefficients Beta	t	Sig.	Tolerance	VIF
Innovation Strategy Factors	Tech	0.393	0.109	0.410	3.613	0.000	.602	1.660
	Mark	-0.316	0.093	-0.348	-3.415	0.001	.749	1.336
	Enp	0.126	0.097	0.128	1.298	0.197	.804	1.244
	GRSK	0.078	0.090	0.086	0.875	0.383	.799	1.251

Table 4.12 explains the overall model fit through  $R^2$  which is the coefficient of determination, adjusted  $R^2$  and  $F$  statistical test. The value of  $R^2$  explains the amount of variance that can be accounted in the model for the dependent variable. There will be a perfect prediction of the dependent variable in the regression model when the  $R^2$  value is

1, whereas  $R^2$  value of 0 is an indicator that there is no improvement in the power of predictors when multiple regression is used instead of a mean value or baseline prediction. Adjusted  $R^2$  is the variance adjusted to the ratio between the number of predictors and sample size. The  $F$  ratio is the measure for the overall significance of the model, which explains whether the variation explained by the regression model is greater than 0, or the baseline predictor.

The unique contribution of each factor towards the business growth is explained by Standardised Beta Coefficients, which is presented in Table 4.13

The model explained 18.7% of variance, i.e., 18.7% of possible variation in the importance placed on business growth is associated with a group of innovative strategy factors, with statistically significant regression model with 5.751  $F$  value ( $p < .01$ )

Of all the factors, the Technology factor has a greater coefficient of 0.410. This explains the positive influence of the technology in the business growth. It also implies, if the business growth of the firm is influenced from the innovation strategy of the firm by one more unit, 0.410 units are expected to come from the technology factor. However, the Marketing factor has shown a negative influence with a negative coefficient of -0.348. This is a surprise result and there could be many reasons, which might be related to this particular study. This aspect is discussed in detail in the discussion chapter.

The Entrepreneurial factor has a coefficient of 0.128 and has a positive influence on business growth. However, the Government-related risk factor has a low coefficient of 0.086. Though its influence is low among other factors, it does have a positive influence on business growth. The result is discussed in detail in the discussion chapter.

## 4.8. Conclusion

This chapter discussed the validation of the all measures used in the survey questionnaire of this research work. Through an initial factor extraction method, two items from the Marketing factor were removed and five items from Risk from business environment factors were removed. Based on the nature of the items which loaded to risk factors, it was renamed as Government-related risk factor. The hypotheses were tested using multiple regression analysis.

Three of the proposed hypotheses related to the Technological factor, Entrepreneurial factor and Government-related risk factors were accepted. However, the hypotheses related to the Marketing factor were rejected. The implications of these results are further discussed in detail in the following discussion chapter.

## CHAPTER 5: DISCUSSION

### 5.1. Introduction

This chapter presents a critical analysis of the data findings, which were reported in the previous chapter. It also evaluates the importance of the research findings and their implications in relation to existing studies and current business practices. The main purpose of this chapter is to establish a link to previous studies to explore the similarities and contradictions that exist in this research outcome. Using the hypotheses and theoretical framework as a base, the findings from the statistical analysis are discussed. The chapter also discusses what the results mean to a SME and their implications for future research.

### 5.2. Discussion of the Statistical Analysis

This study was based on three main research streams: Innovation, Strategy and SMEs. It followed the definition of innovation proposed by the OECD. The existing body of literature on innovation has looked into various aspects of innovation, and the best way to exploit innovation to reap maximum benefit from it. These studies are based on various theoretical ideologies. However, this study examined innovation from a strategic point of view and was based on literature which largely adhered to the RBV and Dynamic Capabilities of the firm. According to Rumelt (1984), a firm can have a competitive advantage by appropriately allocating tangible and intangible resources at its disposal. However, a firm has to develop a competitive advantage in various departments and these will affect the capacity of a firm to achieve maximum growth. The research study critically evaluated the factors which are an part of an innovation strategy. The assumption of the study was based on the strategic management literature, where some of the factors have a greater influence on the success of the firm, hence they need to be given high importance and any change in the environment related to these factors needs to be constantly evaluated. These factors need to be part of a strategic plan to which the company needs to adhere for positive growth of the firm. The factors that were identified in this study are technological factors, marketing factors, entrepreneurial factors and government-related risk factors. The influence of these factors on the business growth of the firm is discussed in the following section.



### 5.3. Technological Factors and Business Growth

The positive relationship between technological factors and business growth was established by this study. This confirms the important role played by the technological factor and technological innovativeness in the business growth of the firm. This result confirms previous studies which have established a strong relationship between technological factors and the success of innovation, leading to higher performance and business growth (Strecker, 2007, Gatignon et al., 2002, Song and Dyer, 1998). The study also confirms that high-technology firms who participated in the survey are using core and unique technologies that are new to the industries and these technologies are expected to bring considerable changes in the industry.

Adoption of new technology plays an important role in the success of an innovation strategy. The research carried out on R&D and the adoption of new technology in SMEs, emphasising using core technologies which are new and unique, gives them a competitive advantage and propels the business growth (Bowns et al., 2003). Technological factor correlated positively with business growth and appeared to be the best factor with highest contribution to the business growth ( $\beta = 0.410$ ). This study generally supports the existing literature that the newness of the technology used positively affects the business growth. Table 5.1 summarises the technological factor variables on the basis of their strength within the factor.

**Table 5.1: Technological variables in order of loading strength**

1	A majority of our innovations use technologies that have an impact on or cause significant changes in the whole industry. (Tech 4)
2	A majority of our innovations involves technology that makes old technologies obsolete. (Tech 2)
3	A majority of our innovations, uses new technologies that permit quantum leaps in performance. (Tech 3)
4	A majority of innovations is based on substantially a core technology never used in our industry. (Tech 1)
5	A majority of our innovations, uses technologies which represent minor improvements over previous technologies. (Tech 5)

The Tech 5 variable was used as a reverse item and this confirms there was no irregular response behaviour of the participants and the data collected is of high quality.

This study has confirmed the previous study of Strecker (2007), which considered technological innovativeness as an important factor in an innovation strategy. High-technology SMEs depend on cutting-edge technology for their innovation. The study clearly establishes the fact that these high-technology SMEs are highly innovative. Their innovation and growth, as economists have clearly established, is good for the economy. It is a widely accepted phenomenon that successful innovations in the high-technology SMEs have a greater influence within the industry and they further lead to many more innovations even in other industries. Using cutting-edge technology will further influence the success of new product and service development.

The firms are also confident that their innovations use new technologies that increase performance considerably. For any new innovation to be successful, they also need to use new technologies which can increase the performance of their new product and service development. New technology-based radical innovation can help the firm to realise product differentiation by achieving better price-performance improvements which is not possible using old technologies. A high-technology firm tends to create a new portfolio of new products which might result in synergies between various projects and speed up the process of learning as well as capability development.

The research outcome for technological factor is in line with the framework and models discussed in the literature review. The radical and incremental innovation model (Holan and Patricia, 2013), Abernathy and Clark (1985) Model and Open technological innovation paradigm (Chesbrough, 2006) all support the role played by technological factors in business growth. These models have emphasised the importance of technology as a resource and capability which will give the firm sustainable competitive advantage and will determine the type of pattern of the innovation success that the firm is going to achieve.

However, this research outcome contradicts with the De Faria and Dolfsma (2011) argument that technology will not contribute to the success of the innovation and business growth, unless it is combined with other capabilities and resources. Technological

capability alone will not assure the success of innovation strategy and it might even fail to support the business growth of the firm if a linear model of innovation is adopted. If the technological knowledge fails to combine with the knowledge management capability and also if the firm fails to combine existing technological resources and knowledge with the emerging technology then the firm will fail to garner any positive growth from the technological capability (Schoenmakers and Duysters, 2010).

This study helps to empirically prove that technological factor as a resource will help the firm to achieve their success. Hence, it is important that technology factors are given high importance in the formation of an innovation strategy.

#### 5.4. Entrepreneurial Factors and Business Growth

The positive relationship between entrepreneurial factors and business growth was established by this study. This confirms the important role played by entrepreneurial factors which was established by previous academic researchers (Hamel and Prahalad, 1994, Slater and Narver, 1995, Atuahene-Gima and Ko, 2001).

The results of this study confirm Lumpkin and Dess (2001)'s findings, which established a positive relationship between entrepreneurial orientation and firms' performance. Entrepreneurial orientation in this research work is described as strategy-making processes, structures and behaviours of firms characterised by innovativeness, proactiveness, risk-taking behaviour, competitive aggressiveness and autonomy, and facilitating the pursuit of opportunities. Their study argued that firms with proactive entrepreneurs performed well in a dynamic environment.

Entrepreneurial orientation is distinguished with three important characteristics: highly innovative, risk-taking and proactiveness (Atuahene-Gima and Ko, 2001). The literature also suggests that owner/ managers in high-tech firms mostly possess a professional qualification and come with past experience. This enables them to involve themselves in the process of innovation at every stage and this will have a positive impact on the success of the firm (Baron and Gideon, 2000). Entrepreneurial factor correlated positively with business growth and appeared to be the second highest positive contributor to the business growth ( $\beta = 0.128$ ). This study generally supports the existing literature that the pro-

activeness of an entrepreneur positively contribute to the the business growth. Table 5.2 summarises the entrepreneurial factor variables on the basis of their strength within the factor.

**Table 5.2: Entrepreneurial variables in order of loading strength**

1	The CEO encourages change and creates the right climate for the implementation of innovation. (ENP 7)
2	The CEO is involved in new product/service development. (ENP 1)
3	The company makes innovation happen through strong, clear vision. (ENP 4)
4	There is a long term commitment to innovation. (ENP 5)
5	The CEO is committed to building relationships with employees and there is mutual support and trust. (ENP 2)
6	The CEO has previous experience with product/services development alliances. (ENP 3)
7	There is a clear allocation of the resources for the implementation of innovation. (ENP 6)

All the entrepreneurial measurements used formed one group measuring the entrepreneurial construct. However, ENP6 also showed a strong association with technological factor measurement. The reason for EPN6 aligning more strongly with technological factor might be due to the wording of the statement/ question. EPN6 talks about the clear allocation of the resources for the innovation. This study used ENP6 to measure entrepreneurial orientation, as this will give a clear indication of the CEO's intention and the will to give development of new products or services all the support it needs for its success. Hence, this measurement was retained with the entrepreneurial factor.

Another study by Wiklund and Shepherd (2003) also established a positive relationship between entrepreneurial orientation and the performance of SMEs. The study, which took a resource-based approach to investigate the relationship, used data from 384 Swedish SMEs. The study confirmed that entrepreneurial orientation or factors moderate the relationship between knowledge-based resources and firm performance. The knowledge-based resource was referred to for discovery of an opportunity and the exploitation of the same. The willingness of an entrepreneur to be innovative and proactive enhances the

“positive impact that the firm’s bundle of knowledge-based resources has on performance” (Wiklund and Shepherd, 2003). This finding is consistent with strategy scholars’ argument about a positive relationship between firm’s resources and its performance and growth.

Traditionally, the debate over strategic determinants considered market-pull and technology-push. However, Salavou and Lioukas (2003)’s work considered entrepreneurial orientation as one of the driving forces which is strategically very important in fuelling innovative activities, particularly in SMEs. This is established by pro-activeness and risk-taking attitudes of entrepreneurs.

It is evident from previous studies that directors have emerged as the most influential decision-makers in a SME (Murphy and Ledwith, 2007). Success of innovation lies in the right way of executing the project, which is influenced by internal characteristics of the organisation, in particular of the manager/ owner’s attitude (Damanpour and Schneider, 2006). Strategic management literature has discussed in detail the role of strategic leadership in bringing a change in an organisational culture in a firm and its effects on all aspects of the business.

Salavou and Lioukas’ (2003) work which looked at the influence of active entrepreneurs and passive entrepreneurs on product innovation success, confirms the important and positive role played by entrepreneurial attitudes in the success of the product innovation. The research work surveyed 149 manufacturing SMEs in Greece and the outcome clearly establishes that characteristics of an entrepreneur are indicative of level of product activities and return on assets. Firms with active entrepreneurs will be active in introducing more product innovation with higher levels of uniqueness and also more efficient in exploiting the assets of the firms which will help is to create a higher return on assets.

Innovations are carried out in teams as opposed to inventions and leadership role plays an important role in creating an environment which is conducive to carry out the innovation. Openness to express one’s idea at every stage of the innovation process and trust among the team members is very important, as there are many risks and uncertainties at various levels of this process, which need to be shared among co-workers to find a better solution. Senior management’s attitude is perceived to be directly proportional to the success of the innovation, and without clearly defined vision and goals, innovation can be misdirected or

unguided. Senior management should set the context of innovation and guide the process by establishing clear communication within the team and organisation, and committing appropriate resources.

Ducker (2014) argued entrepreneurial and leadership of the firm contribute to the systematic innovation which looks for the organised search for purposeful and changes. A higher level of entrepreneurial orientation tends to intensify the success of innovation and performance of the firm. This study confirms with the RBV theory that resources can influence performance. Entrepreneurial factor influences the business performance both directly and indirectly by being the key stakeholder innovation management. They also have a considerable level of influence on all key stakeholders of innovation management. Entrepreneurs need to be aware of the importance of knowledge acquiring and sharing and they need to work continuously on this capability. Pro-activeness on the part of entrepreneurs can help the firm to anticipate and act upon the future needs of the innovation management team which will strategically help the success of the innovation. This argument is confirmed by the works of Lumpkin and Dess (2001) and Wiklund and Dean (2005).

The main criticism on entrepreneurial factor in relation to business growth is, entrepreneurial factor might not be able to influence the innovation outcome after a certain threshold and it might even turn negative (Ferreira and Azevedo, 2008). This argument was emphasised in the work of Schillo (2011). Though their innovativeness, risk-taking ability, proactiveness, autonomy and proactiveness look very encouraging for the innovation success, some of these characteristics themselves might undo the positive influence on business growth. Any miscalculation in their aggressive competitiveness and risk-taking ability will have severe repercussions on success of the innovation and business growth of the firm.

Though entrepreneurial factor in itself might not have a huge positive impact on the performance of the firm, it does contribute towards the business performance of the firm and this should become an integral part of an innovation strategy.

## 5.5. Government-related Risk Factors and Business Growth

The results of this study highlight the Government-related risk factor and its influence on business growth. Though initially this variable was named Business-related risk factors, it was renamed Government-related risk factor after exploratory factor analysis where six of the businesses-related risk factors failed to load with a variable. Hence, only those six measured related to government-related measurement variables for risk factor were retained for further analysis.

The measurement variables were based on Freel (2005b)'s work on perceived environmental uncertainty and Innovation in Small firms. However, the business environment-related variables dropped out, whereas government-related variables formed a group. Reasons for this may be: 1) the questions may have been ambiguous and participants might have related these questions to marketing factor rather than business risk factors as these variables were based on market, customers and competitors. 2) This may be an internal validity issue for this particular variable and future researchers should endeavour to test this variable in more explicit ways.

However, the government-related factors formed a group and this showed a positive relationship with business growth. This confirms the work of Freel (2005b) which argued that increasingly complex and demanding information with reference to the regulatory environment is less favourable to innovative activities. This study's results showed that firms have to constantly make changes to their business operation due to changes in government policies and regulations to have a positive growth. In line with the outcome of the study, one may plausibly speculate that the changes in government regulations put pressure on innovative activities and firms have to have the dynamic capabilities to respond to the changes quickly.

As discussed in the literature review chapter, external environment factors influence a firm's capacity to innovate and also the innovation itself (Neely et al., 2001). Decision-makers respond to the lack of information through responses that attempt to adapt their organisation. The optimum alignment between strategy and environmental conditions helps a firm to have positive growth. Government policies, as well as the changes in the market environment, are the biggest risk factors that a firm needs to be aware of and have

a plan to address. The firm also needs to respond quickly to any changes that it faces in order to keep the firm in the path of growth.

In previous studies, some external factors were identified that encourage innovation. They are availability of public funds and grants, economic environment and government regulations that support innovation, local business networks, contact with research-oriented universities, and access to science and technology (Neely et al., 2001). Government-related risk factor correlated positively with business growth and appeared positively contributing to the business growth ( $\beta = 0.086$ ). Though the level of contribution is less in comparison with technology factor and entrepreneurial factor, one needs to understand, this is an external factor. Table 5.3 summarises the Government-related risk factor variables on the basis of their strength within the factor.

**Table 5.3: Government-related risk variables in order of loading strength**

1	Foreign direct investment regulations and restrictions. (GRSK 3)
2	Intellectual laws which make companies liable to follow the new standards set by government. (GRSK 5)
3	Import / Export benefits and restrictions. (GRSK 4)
4	Tax benefits of the company. (GRSK 1)
5	Government funding for R&D. (GRSK 5)

Business-related variables failed to load on the risk factor, whereas all government-related variables loaded highly. Foreign direct investment regulations and restrictions, intellectual laws, import/ export benefits and restrictions have greater value of loading in measuring risk factors than tax benefits and government funding for R&D. This may reflect increasingly globalised competition and the importance of government activity in boosting or restricting the international trade and protection of intellectual property.

The business environment-related variables did not show a significant loading together, nor with the government-related risks. The only conclusion could be this unit of analysis is very diverse and responses to these questions are very different. Hence, the business environment variables are dropped from the model.



Zhu et al.'s (2012) research work studied the institution-based barriers to innovation in SMEs and found competition fairness, access to financing, laws and regulations, tax burden, and public support systems can hamper the innovation activities of SMEs. They argued that innovations are fundamentally unpredictable and risky and innovations in SMEs are even more risky and unpredictable, due to their size and access to resources. This condition of SMEs necessitates more nurturing and support. Though their study was carried out in China, which is very different from the UK with regard to political and socio-cultural situation, it highlights some of the institution-based factors which can nurture the innovation in SMEs which are applicable to all countries. Our study confirms high-technology SMEs in the UK are also influenced by institution-based factors and they do have to make constant changes to their business operation, which has a positive effect on their business growth.

Love and Ganotakis' (2013) study also showed a significant effect of governmental support for the development of innovative products and services, on the introduction of the products into the market as well as their export. In this study, a survey was carried out in UK and 412 new technology-based SMEs participated. The current study confirms the results of that study and shows that there is a positive relationship between firms making necessary changes in their firm in response to import and export regulations and business growth.

The results of our study is also in line with Demirel and Kesidou's (2011) research work, which concluded government regulations do have an influence on innovation outcome. Their study was carried out using 289 manufacturing firms which are involved in R&D in the UK.

This study establishes the link between government-related factors which have an effect on innovation processes and are not in control of the management. The existence of uncertainty in the macro environment and industry due to government regulations can have a greater effect on smaller firms, as larger firms can effectively exploit these regulations. Poor macro-economic conditions will affect the high-technology SMEs and they tend to adopt risk-averse strategies which will not have a positive influence on innovation and business growth. This argument was supported by empirical studies carried out by Oakey

(1994), Dickson et al. (1995a), Moore (1989) and Keeble (1993), who studied the environmental factors which are controlled by governments.

Open innovation paradigm, discussed in the literature review, emphasises on the external network and alliances to develop capabilities. The firms have to be dynamic in dealing with external partners and this can also be determined by many government regulations. The regulations on partnering with a firm outside the country might be subjected to certain regulations which can be a supporting factor as well as a hindrance. The regulations can protect the firm in case of any fraud, intellectual property theft, licensing disputes etc, whereas it can also bring some regulations which will restrict the level of exchange they can have with other firms. The importance of external linkages to the success of innovation is confirmed by the empirical works of Beesley and Rothwell (1987), Faulkner and O'Connor (1989), Buisseret and Cameron (1994) and Duff and Gearing (1995).

Though there is a large effort by policy makers to provide support to high-technology SMEs, it is very difficult for the government to reach the requirements of all high-technology SMEs in various sectors. There is a general criticism of the government support which was empirically captured by many researchers such as Joyce et al. (1993), Adam-Smith and McGeever (1995), Hoffman et al. (1998) and Lazzarini (2015). The lack of clear policy structure sometime ends up supporting start-ups but failing to provide sustainable support to existing firms.

There are many risks which are related to law, regulations and available support systems. The high-technology SMEs carefully negate these limitations and work towards managing these risks and uncertainties for the success of the innovation and business growth. A positive relationship was established between business risk factors and business growth. Hence, it is important that government-related risk factors are given due importance within an innovation strategy.

## 5.6. Marketing Factors and Business Growth

The result of this study has a surprising finding with reference to marketing factors. The influence of marketing factors on business growth showed a negative relationship and the

hypothesis that was proposed “marketing factors have a positive influence on business growth” was disapproved. Hence the proposed hypothesis is rejected.

As discussed in the literature review, micro-economists emphasise the interaction among market and organisational factors in determining innovative performance (Fagerberg, 2005). It is found that in the initial stages of the innovation process, if marketing and sales teams were involved, the results were positive for innovation. Firms have to consider market demands and opportunities to have successful innovation (Roper, 1997). Innovations stimulated by market orientation usually align with the need of the customers, so new products/ services are highly valued by the customers. This also helps the firm to anticipate and respond quickly to the emerging needs of the customers. However, in this study marketing factor correlated negatively with business growth and appeared contributing negatively to the business growth ( $\beta = -0.348$ ). Table 5.4 summarises the marketing factor variables on the basis of their strength within the factor.

**Table 5.4: Marketing variable in order of loading strength**

1	We have the ability to introduce new products more quickly than our competitors. (MAK7)
2	The majority of our innovations requires changes in established attitude and behavioural pattern from our customers. (MAK3)
3	The majority of our innovations address completely new customer benefits. (MAK1)
4	The majority of our innovations offer our customers the unique advantage over competitors' products. (MAK2)
5	We have the ability to customise products to individual customers' needs. (MAK8)
6	The majority of our innovations are similar to our main competitors' products. (MAK6)
7	Our mainstream customers require major learning efforts to use the majority of our innovations. (MAK4)
8	The majority of our innovations involve high switching costs for our mainstream customers. (MAK5)

The MAK 5 variable was used as a reverse item and this confirms there was no irregular response behaviour of the participants and the data collected is of high quality.

MAK 4 did not load in the component matrix and it was removed. These measurements were taken from (Strecker, 2007). The results of this study contradicts that of Strecker. This could be attributed to the unit of analysis of this study. This observation may be due to the fact that high-technology firms may have either a linear model of innovation (push) or a non-linear model (pull). The majority of the high-technology SMEs participating in this study are involved in innovation which is not specifically targeted at a niche market where customers are expected to invest more on learning the technology or invest more on switching from one technology to another.

Marketing measurements were drawn from two research works: Strecker (2007) and O'Regan and Ghobadian (2005). When finally modelled, the marketing factor showed a negative relationship with business growth. This could be attributed to the unit of analysis of this study. This study implies that high-technology SMEs may predominantly use the technology-push model and be less dependent on a marketing function for business growth.

Cooper (2013) in his recent work on the drivers of new product success discusses the little importance given to a fine-tuned marketing plan which is appropriately backed and resourced. A strong orientation is missing in many product development projects and detailed market studies are absent in the majority of the projects. Marketing activities give least importance and are the lowest- rated activity with reference to the new product development process. The quality of execution of the marketing plan is rated far below in comparison with technological actions. It is also noted that relatively few resources are dedicated to marketing actions. Though the study discusses the importance of marketing for the success of a new product and calls for including marketing factors in the product project plan in the early stages itself, it highlights the lack of importance given to marketing by product development firms and as they strongly believe in their technology and tend to give only lip service when it comes to allocating resources to marketing activities. This can explain the results of our study. As SMEs have limited resources, especially finance, they might be willing to spend it on technology rather than on marketing. Many of the high-technology SMEs might not be willing to spend the money on marketing activities and might consider it as a waste of resources at the product development stage, as they might not be targeting a wider customer base. Many of the

high-technology SMEs are the suppliers of technology to larger firms and in many cases serve specific customers.

Another work by Love and Ganotakis (2013) also conforms with the results of this study. The study, which was based on 157 SMEs in Turkey, also found a negative direct correlation between market orientation and innovativeness of the firms. However, their study noted market orientation positively influences the learning orientation which in turn influences the firm's innovativeness. This study did not use any mediating factors, and tested only a direct relationship. There might be an indirect relationship between marketing factors within innovation strategy and business growth which needs further investigation.

Another reason for a negative correlation could be the size of the participating firms. Majority of the firms who participated in this study are micro firms. Micro firms depend on their technological push for the business growth. Their investment on marketing might drain their limited resources without any positive returns. Hence the participant's perception on marketing factors as a contributor to business growth might be negative.

Though meticulous market research and partnership is considered as an important factor in co-creation (Prahalad and Ramaswamy, 2004) which will facilitate better commercialisation of the innovative product and services, due to limited resources high-technology SMEs might keep away from these activities. Marketing factors are also considered as a financial burden as SMEs are cashstrapped in general. However, increasingly there are many large corporations which are partnering with high-technology SMEs for product and service developments and they are sufficiently supported with adequate funding. These firm's marketing activities will be taken care of by the big corporations and these high-technology SMEs do not concentrate on the marketing of their products or services. Some of the high-technology firms are also not looking at traditional marketing models as their target audience is not customers but other businesses and they might use other methods to reach out to these business.

From the above arguments presented, it is clear marketing factors are very complex when it comes to high-technology SMEs and this needs further empirical research to understand these complexities and determine the relationship with innovation management, firm performance and business growth. Hence, the proposed hypothesis is rejected.

## 5.7. Business Growth

It is argued that innovation strategies help the firm to adapt to changes in its environmental circumstances and play an important role in enhancing business performance and growth (Morgan and Berthon, 2008, Song et al., 1999). The business growth which is a dependent variable was measured with five variables. Table 5.5 summarises the business growth factor variables on the basis of their strength within the factor.

**Table 5.5: Business growth variable in order of loading strength**

1	We have expanded our market share consistently in the last five years. (BGR1)
2	There is a constant increase in the return on our investment in the last five years.(BGR4)
3	We have increased our assets constantly in the last five years. (BGR3)
4	There has been a constant increase in the number of employees of the organisation in the past five years. (BGR2)
5	We are confident of doubling our financial turnover in the next five to ten years. (BGR5)

All the variables grouped together in the factor loading and this confirms some of the previous studies with reference to business growth measuring variables (Barringer et al., 2005, Terziovski, 2010a, Dobbs and Hamilton, 2007, Adams et al., 2008b). This study tried to determine the growth of the business with an approximate growth in terms of market share, employee number, increase in asset ROI and their confidence regarding doubling their financial turnover in the next five to ten years.

Increase in market share showed higher confidence, whereas they do not seem to have strong confidence in doubling their financial turnover. This could be attributed to the time of the data collection. Data was collected in 2012 and 2013. Due to the recession from 2008 and a cut in government funding in the past few years, the firms seem to have lost confidence in economic growth and are doubtful about doubling their financial turnover. However, the appropriate measures were used to measure growth and the relationship between innovation strategy factors and business growth can be considered as valid.

## 5.8. Conclusion

This chapter discussed the results of the research work in detail and established their link to existing literature. Technological factor, entrepreneurial factor and government-related risk factors showed a positive relationship with business growth whereas marketing factor showed a negative relationship. High-technology SMEs depend on their technology capability and they are more guided by technology-push in their innovation. It is also noted that entrepreneurial factor does play an important role in the success of the innovation and it does need to be a part of innovation strategy. It is noted that high-technology SMEs do make changes to their business processes frequently in order to respond to institution-based uncertainties. However, business-related risk factors and marketing factors and their role in innovation success need further research and exploration. The next chapter summarises this research by discussing academic and practical contributions of this study and its implications, limitations and recommendations for future studies.

## CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

This chapter summarises the research study carried out to determine the role of innovation strategy in the business growth of high-technology SMEs and its outcome. It revisits the research objectives and questions, and confirms answers to the research questions and how the research objectives of the study have been met. It also outlines the research's contributions to theory and practice based on the research context of this thesis. The limitations of the study are presented and recommendations for future study to further advance the knowledge on this research subject are presented.

### 6.1. Revisiting the Research Background and Research Objectives

The thesis addressed the research problem contributing to the ongoing debate regarding the relevance of innovation strategy in the business growth of high-technology SMEs. The research on innovation strategy has seen an increase in recent years and is a very young research stream. The research gap was found in the research on innovation strategy in high-technology SMEs. Though there is a considerable amount of research work carried on the subject of innovation strategy in the last ten years, a high number of research works are dedicated to large companies. Research on SMEs have established that SMEs have unique characteristics which are very different from large companies. They behave and respond to the environment differently (Yang et al., 2014). With this background, this research was carried out to determine various factors which form a part of an innovation strategy and the business growth of the firm. This study looked at the innovation strategies of high-technology SMEs in the UK, as high-technology firms are highly innovative and their growth contributes to the economy immensely. Therefore, the aim of this research study was to examine the innovation strategy used in high-technology SMEs and their role in the business growth of these firms. To realise the aim of the study, the following objectives were set.

- To explore the ongoing research, important theories and debates on innovation strategy and business growth of high-technology SMEs.
- To develop important indicators of innovation strategy and integrate them into a model that will have maximum influence on the business growth of an SME.



- To test the hypotheses, underpinned by existing theories, to understand the influence of innovation strategy on business growth in high-technology SMEs and in doing so to add to the existing body of knowledge.
- To present propositions for future research on innovation strategy in high-technology SMEs and inform practice.

## 6.2. Research Approach

The objectives of the study were addressed in two phases. First, a detailed literature review was carried out. The research was based on the theoretical perspective of a resource-based view and dynamic capabilities of companies, both of which provided a basis on which to develop the research design to conduct this study. The existing literature on innovation and innovation strategy in SMEs, business growth and high-technology SMEs were explored and a detailed critical analysis of the literature was carried out. Thus the first objective of the research is addressed.

The literature review helped to identify various approaches taken by previous studies to address the concept of innovation strategy. Keeping the theoretical perspective of this study as a base, key factors of firm-level innovation strategy of a high-technology SME are identified. Four factors are found to be an important part of an innovation strategy, which influences the success of the innovation strategy and business growth. A theoretical model was proposed to illustrate the relationship between innovation strategy and business growth. Four hypotheses were proposed to test the model and relationship further. Thus, the second objective of the research is addressed.

The second phase was to test the proposed hypothesis. To address the third objective of the study, a deductive approach and a survey strategy were used to collect data on innovation strategy and business growth in high-technology SMEs. This research approach was taken in line with a positivist philosophical paradigm. To test the proposed hypothesis, which would establish the relationship between innovation strategy factors and business growth, a quantitative data collection method was used to collect the primary data. This method was found to be the most appropriate method for this study, based on the research approach of the study as well as previous studies on the subject. A survey questionnaire was used to collect the data. The questionnaire used 32 items to measure technological

factor, marketing factor, entrepreneurial factor, risk/business environment factor and business growth.

A mail survey questionnaire was sent to 830 high-technology SMEs and an online survey questionnaire link was sent to 423 through emails and LinkedIn. A total of 1253 questionnaires was administered to the targeted research study sample and 149 responses were received, out of which 106 were valid to use for this study.

A multiple regression analysis was carried out to test the proposed model and hypothesis. The data collected through the survey questionnaires were analysed and the model was tested using SPSS 19 software. Exploratory factor analysis was carried out to assess the validity and reliability of the measurement model. The validity of the measurement model was tested through face validity and content validity and reliability was tested through the Cronbach's alpha value indicator. Multiple regression analysis was carried out to test the model through R-Squared values and significance values. Thus, the third objective of the research study is addressed.

### 6.3. Summary of the Key Research Findings

A number of key findings emerged from the literature review as well as from testing the relationship between innovation strategy and business growth of a high-technology SME, through a proposed theoretical framework for an innovation strategy of a high-technology SME and also through testing the proposed hypotheses.

#### 6.3.1. Identification of research gaps

The first objective of the study helped to identify the research gaps in the existing literature on innovation strategy. An in-depth critical analysis of the literature on innovation strategy revealed many gaps in existing research work, as research on innovation strategy is in its early stages. The following are the research gaps identified by this research study:

1. The research on innovation strategy is multidimensional and there is a lack of consistency in defining the concept of innovation strategy.
2. The research on innovation strategy in high-technology SMEs is very limited.

3. There is very limited research to determine the factors that constitute an innovation strategy in a high-technology SME.
4. There is very limited research to determine the relationship between innovation strategy and business growth of a high-technology SMEs.

#### 6.3.2. A proposed model for innovation strategy and its influence on business growth

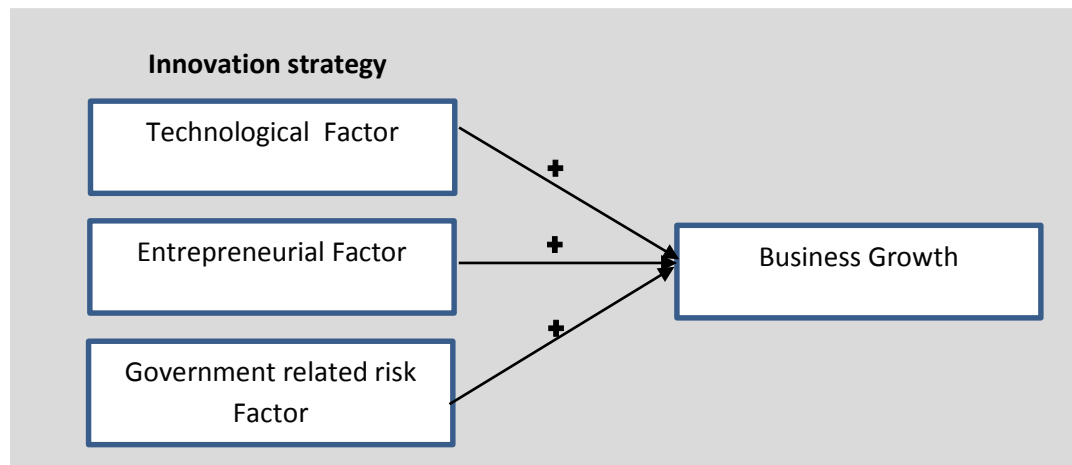
Based on the literature review and in line with the second objective of the study, a theoretical framework was proposed. The framework included the factors which influence the innovation strategy of a high-technology SMEs and determine the success of this innovation strategy. The hypotheses were proposed to test the relationship between these factors and the business growth of a high-technology SMEs.

Initially, four factors were proposed as the determinants of a successful innovation strategy. They were identified keeping the resource-based view and dynamic capabilities theory as the base. These factors also included keeping the characteristics of a high-technology SMEs which is distinctive in comparison with large companies. Four main hypotheses were proposed to test the model.

The proposed hypotheses were tested through a quantitative method, using a survey questionnaire as the primary data collection tool. This successfully addressed research objective three. A final model was presented based on the outcomes of the quantitative data analysis and proposed hypothesis testing. The theoretical model and results of the hypothesis testing are summarised as follows:

- |    |   |                 |
|----|---|-----------------|
| H1 | There is a positive relationship between technological factors and business growth.           | <b>Accepted</b> |
| H2 | There is a positive relationship between marketing factors and business growth.               | <b>Rejected</b> |
| H3 | There is a positive relationship between entrepreneurial factors and business growth.         | <b>Accepted</b> |
| H4 | There is a positive relationship between Government-related risk factors and business growth. | <b>Accepted</b> |

Based on the outcome of the hypothesis testing, a modified framework was presented. Figure 6.1 illustrates the final version of the theoretical framework.



**Figure 6.1: Final version of the theoretical model**

The results of the study show that three factors which make a part of an innovation strategy have a positive influence on the business growth. However, it also shows the factors which make a part of an innovation strategy of a high-technology SME are not entirely similar to that of a large company. In this study, the second hypothesis proposed based on the marketing factors was rejected. This could be attributed to the characteristics of high-technology SMEs which is different from low-technology SMEs or a larger firm. The majority of the high-technology SMEs are involved in R&D and radical innovations. When they are involved in radical innovations, they are creating needs rather than responding to needs. Even with some of incremental innovations, high-technology SMEs might be creating a solution to an uncertain need in the market. These factors make the traditional way of marketing challenging for a high-technology SME. Marketing factors were not significant in terms of their contribution to the business growth for this unit of analysis. As discussed earlier, the majority of the firms that participated are micro firms and they may have a different approach to their innovation in comparison with small and medium-sized firms.

Another reason could also be the aim of the high-technology SMEs. The high-technology entrepreneurs are increasingly becoming serial entrepreneurs. Rather than targeting the traditional market for their growth, driven by market-pull, they might be depending on their technology success and aiming to sell the firm to a larger firm. This finding also

supports the findings of Gliga and Evers (2010) which recognised the traditional marketing challenges faced by high-technology SMEs.

The fourth and final objective of the research study was to contribute to theory and practice and create a link between past and future research work by providing suggestions to future researchers. This is addressed in the following section.

## 6.4. Research Contributions to Theory and Practice

This research study on innovation strategy makes a significant contribution to theory as well as practice. Theoretically, the study has taken a step forward in the academic research area of innovation management in high-technology SMEs, keeping the resource-based view and dynamic capabilities perspectives as a base. The contribution to practice is found in identifying important factors of an innovation strategy which have high influence on business growth of a high-technology SME.

### 6.4.1. Theoretical Contributions

The study presented a research model based on the factors that form an important part of innovation strategy in a high-technology SME. The research gap found in the initial literature review is addressed by this study and it has added to the limited knowledge available about the innovation management and innovation strategy in SMEs. As SMEs have their own strength and weaknesses, the innovation strategy has to capitalise on their strengths and try to overcome their weaknesses. It is very important to recognise the important factors which need to be given due diligence, as they will have positive role to play in the business growth of the firm, which in turn can fuel their further innovations. This study has confirmed certain existing arguments in the literature and has also a contrary view on certain factors. Technological factors, entrepreneurial factors and government-related environment factors emerged as important factors which have a positive role to play in the business growth. These findings are in confirmation with the previous (Strecker, 2007, Salavou and Lioukas, 2003, Love and Ganotakis, 2013) This study confirms the importance of these factors with reference to high-technology SMEs in the UK which add value to the existing literature.

However, the marketing factors did not confirm with the proposed hypothesis. This is one area of research which needs further empirical research. Marketing factors are considered as complex in nature in determining the future course of certain types of innovation and this is one research area which needs a different approach to high-technology SMEs. This study is just one approach to the marketing factor and this will give greater insight into the role of the marketing factor in the innovation management of high-technology SMEs. This unit of analysis needs further investigation to determine the role of marketing in innovation performance, as well as business growth. The risk factors studies in this research are another important contribution to the theory. This factor showed a positive influence on business growth. However, the study established a strong influence of government-related risk factors in determining the risk factor. This confirms with the previous studies of (Freel, 2005b). However, some of the environmental factors related to market, customers and competitors did not measure the risk factors in the way it was structured initially. This has explored the various directions that environmental factors could be measured.

The research also based its study on the resource-based view and dynamic capabilities explored the theoretical base with reference to innovation strategy in SMEs. The resource-based view is widely used, theoretical based on the firm-level research on SMEs. The resource-based view and dynamic capabilities are complimentary to each other and dynamic capability theory is widely used in strategic management literature. This study contributes to the use of both theories to explore innovation strategy and its relations to business growth.

This study also contributes to the literature on innovation strategy and addresses the issue of lack of clarity on defining the innovation strategy of a high-technology SME and on further determining factors which define an innovation strategy. However, as the academic research on innovation strategy in SMEs is in its infancy and is multidimensional in nature, this research serves as a building block in the huge research stream that will grow in the future. Innovation strategy in high-technology SMEs needs to establish a firm base of its own and then systematically establish various streams that stem from this research base. These streams need to explore various innovation strategies for different types of innovation systematically, i.e., radical innovation, incremental innovation, product innovation, service innovation, organisational innovation, technological innovation, etc. Over the years, these research streams will help to provide more clarity on innovation

strategies in high-technology SMEs and its various categories. It will also help to establish the similarities and dissimilarities within these categories.

Overall, this study has moved in a positive direction to narrow down the gap that exists in academic research on innovation strategies in high-technology SMEs. In doing so, it has also given an innovation strategy model which can be further developed through future research. The study also has added to the existing knowledge of high-technology SMEs, in particular high-technology firms in the UK. There is a need for more research on innovation strategy in high-technology British firms which are highly innovative and are involved in cutting-edge innovation. There are many new sub-sectors within the high-technology sector which are fast emerging and research needs to respond to these rapid changes systematically.

#### 6.4.2. Empirical contribution

This research study has many practical implications for business as well as policy makers and will help them to make an informed decision in supporting better growth of the firm.

- This study has identified an innovation strategy framework which is relevant for a high-technology SME. However, this framework can also be used by other SMEs to formulate a better innovation strategy which will help them to accelerate business growth. It will also help entrepreneurs and people managing SMEs in incorporating these factors in their innovation strategy, which is important for the success of their innovation.
- The management of the firms will be better informed about the importance of an innovation strategy and its factors as it helps the growth of their business. This can help them to allocate appropriately their limited resources to those factors of the innovation strategy which might have a positive influence on business growth and also in developing appropriate dynamic capabilities to strengthen those areas which will have greater influence on business growth.
- With regard to risk factors, the firm needs to be aware of the uncertainties which might arise from government-related regulations, which can pose potential risks to the success of their innovation, and need to develop capabilities which will help them to respond quickly to any changes in the environment, over which they do not

have any control. These mechanisms to address the risk from potential government regulations needs to be addressed in the innovation strategy with clarity.

- The research also has a practical contribution for policy makers. This thesis has implications regarding the regulatory framework and also helps in creating an informed framework to support the high-technology SMEs, which play a very important role in the growth of the economy. The government can use the key factors of innovation strategy found in this research study in formulating their policies in order to help high-technology SMEs' business growth.
- It is also noted that the majority of the high-technology firms which participated in this study were micro and small firms with less than 50 employees. The size of the firm makes a difference to the availability of resources and their dynamic capabilities. The majority of government regulation and policy makes a distinction between SMEs and large firms. However, it would be helpful to differentiate between micro and small firms.

## 6.5. Limitations of the Study

This research is carried out using all the available resources and time at the disposal of the researcher. Best practices of academic research were followed at each step to achieve rigour in the research process. However, every research work will have certain limitations and results of the study need to be seen in light of these limitations.

- Study of innovation and related topics are complex in nature, which has many dimensions. Innovation strategy is influenced by many factors within the firm and this study looked at only the major factors which have an influence on innovation strategy in a SME. Factors such as human resources management and knowledge transfer were not included due to the difficulty and commercial sensitivity required when working with high-technology SMEs. Location and agglomeration issues were also not addressed, as data access is largely determined by the profile of the unit of analysis.
- Internal validity: This study has followed the common practices of sampling of data collection, and the researcher had access to the database of local businesses through local government, who have partially funded this research work. Despite best efforts, the response to the postal survey was disappointing. Hence, the survey



was made available online. Data distribution of both methods was compared using the *t*-test. However, it is advisable to adopt one approach to collect the data. To overcome the limited sample size, appropriate statistical software was used. However, it is desirable to carry out the research with a greater sample size. The fact that high-technology SMEs are reluctant to participate in surveys should be recognised, especially those working on new innovative products, and also it is very difficult to get an answer to some of the questions directly related to their R&D and finance, which are considered as commercially confidential.

- Though every effort is made to address the internal validity of the measurements used, there are some measurements which have not supported the measuring factor. This could be attributed to the nature of the unit the analysis and future researchers need to test these factors further. Marketing factor and business environment risk factors need to be tested further to assess the strength of the measuring variables.
- Another possible limitation is the fact that only the top management of the firm participated in this survey. This study collected the information from only the top management as they are the ones who make decisions on innovation strategy, as well as having all the information about the higher decisions. However, the opinion of employees at various levels will enrich the knowledge and also will strengthen the framework.
- External validity: The sample size achieved and location limitations limit the generalisability of results, however high-technology SMEs in similar economic circumstances may find the results valid and of interest.
- The majority of the participants are from micro businesses as opposed to medium-sized. Many firms which are involved in R&D, and product and service development cater to a niche market and they tend to be smaller in size. This result might not be entirely applicable to medium-sized firms, which tend to have better access to resources.
- The data were collected from high-technology firms belonging to various industries in the UK. Hence, generalising these results to firms in other countries will have limitations, especially when business environmental factors are very different from those of the UK.

- Though the study has addressed the research gap and developed a theoretical model, this model needs to be tested by future researchers under various business environments before it can be generalisable.

## 6.6. Research Recommendations

There are always new research questions and new subject of interests which emerge from any academic research study. Academic research is a continuous process and is carried on the shoulders of previous research. Every research study has certain scope and limitations which can be addressed by future research studies. The following are recommendations which might be of interest to future researchers on innovation management and strategy.

- Future research works are recommended to complement this study by using various other variables such as finance or organisational culture as separate factors which might have an effect on business growth.
- The marketing factor which was discussed in this study needs further research to establish its relationship with business growth in SMEs.
- The business environment factor needs further research to confirm whether it can be introduced as a separate factor and the extent of its influence on business growth.
- It would be a valuable contribution to research if the framework is tested using data from other developed as well as developing countries. This would help to confirm and generalise the results from this study.
- This research has used existing theories to create a theoretical model to test the relationship between innovation strategy and business growth of a firm which can be tested by future researchers at different locations, as well as being sector-specific.
- This research is theoretically based on RBV and dynamic capability theories. However, there are huge changes happening in the global market and this is also changing the way the SME is traditionally operated. Dynamic changes in technology and communication are creating new avenues for SMEs to acquire resources and capabilities and future research needs look at innovation strategy from these new business models' perspectives.

- Innovation management is a multidimensional research area and there is a need for cross-over research among various subject areas such as business management, economics, finance, marketing, information science etc.
- The government needs to support high-technology SMEs and policies need to create an environment in which innovation strategy factors can be strengthened through collaboration and cooperation among all the stakeholders.
- The government also needs to recognise the differences that exist among micro, small and medium enterprises and policies need to address micro firms separately, as there exist considerable differences among the three categories of SME.

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## Appendix A: SIC Codes used in the study

		<b>Alphabetical Index to the UK Standard Industrial Classification of Economic Activities 2007 - UK SIC 2007</b>
<b>1</b>	<b>SIC 2007</b>	<b>Activity</b>
2	26702	Accessories for photographic equipment (manufacture)
3	26309	Aerial (domestic) (manufacture)
4	26309	Aerial (non-domestic) (manufacture)
5	49319	Aerial cable-ways operation
6	43210	Aerial erection (domestic)
7	43999	Aerial mast (self supporting) erection
8	26309	Aerial reflectors (manufacture)
9	28220	Aerial ropeway and cableway (manufacture)
10	26309	Aerial rotors (manufacture)
11	26309	Aerial signal splitters (manufacture)
12	71122	Aerial survey
13	30300	Aero engine manufacture (all types) (manufacture)
14	30300	Aero engine parts and sub-assemblies (manufacture)
15	90010	Aerobatic display
16	52230	Aerodrome
17	18130	Aerographing (manufacture)
18	30300	Aerospace equipment (manufacture)
19	21100	Antibiotics (manufacture)
20	32500	Artificial eye (manufacture)
21	01629	Artificial insemination activities on a fee or contract basis
22	86900	Artificial kidney unit
23	32500	Artificial limb (manufacture)
24	86900	Artificial limb and appliance centre
25	32500	Artificial parts for the heart (manufacture)
26	32500	Artificial respiration equipment (manufacture)
27	26701	Astronomical equipment (optical) (manufacture)
28	72190	Astronomy research and experimental development
29	26511	Biochemical analysers (electronic) (manufacture)
30	21200	Botanical products for pharmaceutical use (manufacture)
31	62012	Business and domestic software development
32	61200	Cellular network operations
33	26301	Cellular phones (manufacture)
34	26200	Central processing units for computers (manufacture)
35	26301	Communication devices using infrared signal (e.g. Remote controls) (manufacture)
36	77390	Communication equipment rental and operating leasing
37	42220	Communication lines construction
38	26400	Compact disc players (manufacture)

39	18201	Compact disc reproduction from master copies (manufacture)
40	59200	Compact disc sound recording publishing
41	26200	Computer (electronic) (manufacture)
42	26200	Computer (manufacture)
43	62020	Computer audit consultancy services
44	26800	Computer discs and tapes (unrecorded) (manufacture)
45	46140	Computer equipment
46	62030	Computer facilities management activities
47	62020	Computer hardware acceptance testing services
48	72190	Computer hardware research and experimental development
49	18203	Computer media reproduction (manufacture)
50	46620	Computer numerically controlled (CNC) machine tools
51	28410	Computer numerically controlled (CNC) metal cutting machines (manufacture)
52	26200	Computer peripheral equipment (manufacture)
53	17230	Computer print-out paper (manufacture)
54	26200	Computer projectors (video beamers) (manufacture)
55	62090	Computer related activities (other)
56	85320	Computer repair training
57	62020	Computer site planning services
58	26200	Computer store (manufacture)
59	26200	Computer system (manufacture)
60	26200	Computer terminal unit (manufacture)
61	18130	Computer to plate CTP processing of plates for relief printing (manufacture)
62	18130	Computer to plate CTP processing of plates for relief stamping
63	46620	Computer-controlled machine tools
64	46640	Computer-controlled machinery for sewing and knitting machines
65	46640	Computer-controlled machinery for the textile industry
66	47410	Computers and non-customised software
67	46510	Computers and peripheral equipment
68	77330	Computing machinery and equipment rental and operating leasing
69	26200	Control units for computers (manufacture)
70	26120	Controllers interface cards (manufacture)
71	26200	Converter for computer (manufacture)
72	62012	Custom software development
73	18130	Data files preparation for multi-media printing on CD- ROM (manufacture)
74	18130	Data files preparation for multi-media printing on internet applications (manufacture)
75	18130	Data files preparation for multi-media printing on paper (manufacture)
76	61100	Data network management and support services (wired telecommunications)
77	26200	Data processing equipment (electronic (other than electronic calculators)) (manufacture)
78	28230	Data processing equipment (non-electronic) (manufacture)
79	61100	Data transmission (via cables, broadcasting, relay or satellite)
80	26301	Data transmission link line (manufacture)
81	62012	Database structure and content design



82	61100	Dedicated business telephone network services (wired telecommunications)
83	62011	Designing of structure and content of an interactive leisure and entertainment software database
84	62012	Designing of structure and content of business and domestic software databases
85	26200	Desktop computers (manufacture)
86	61900	Dial-up internet access provision
87	26200	Digital computer (manufacture)
88	18130	Digital imposition (manufacture)
89	26200	Digital machines (manufacture)
90	71122	Digital mapping activities
91	26511	Electronic GPS devices (manufacture)
92	26800	Floppy disk (manufacture)
93	26200	Floppy disk drives (manufacture)
94	26200	Hybrid computer (manufacture)
95	26110	Image converters and intensifiers (manufacture)
96	26702	Image projectors (manufacture)
97	18130	Image setting for letterpress processes (manufacture)
98	18130	Image setting for offset printing processes (manufacture)
99	61100	Image transmission via cables, broadcasting, relay or satellite
100	60200	Image with sound internet broadcasting
101	26200	Information processing equipment
102	43210	Installation of computer network cabling and other telecommunications system cables
103	62090	Installation of personal computers and peripheral equipment
104	33200	Installation of telecommunications equipment
105	43210	Installation of telecommunications wiring systems
106	80300	Internet abuse monitoring
107	61200	Internet access providers (wireless telecommunications)
108	60100	Internet radio broadcasting
109	26200	Laptop computers (manufacture)
110	46510	Laser printers
111	62012	Made-to-order software
112	26200	Mainframe computers (manufacture)
113	21100	Microbiological cultures, toxins, etc. (manufacture)
114	26110	Microchip (manufacture)
115	26200	Micro-computers (manufacture)
116	26200	Mini-computers (manufacture)
117	26301	Mobile telephone (manufacture)
118	61200	Mobile telephone services
119	26120	Modem interface cards (manufacture)
110	26301	Modems (manufacture)
111	26200	Network interface (manufacture)
112	26120	Network interface cards (manufacture)
113	72110	Research and experimental development on bioinformatics

114	72110	Research and experimental development on cell and tissue culture and engineering
115	72110	Research and experimental development on DNA/RNA
116	72110	Research and experimental development on gene and RNA vectors
117	72110	Research and experimental development on nanobiotechnology
118	72110	Research and experimental development on process biotechnology techniques
119	72110	Research and experimental development on proteins and other molecules
120	72190	Research association (other than biotechnological)
121	72190	Research chemist (private practice)
122	72190	Research institution (other than biotechnological)
123	72190	Research laboratory (other than biotechnological)
124	28220	Robots designed for lifting and handling in industry (manufacture)
125	28990	Robots for multiple industrial uses (manufacture)
126	30300	Rocket (aerospace) (manufacture)
127	25400	Rocket launch systems (manufacture)
128	30300	Rocket motor (manufacture)
129	26301	Routers for telecommunications (manufacture)
130	26513	Scientific laboratory equipment (non-electrical or non-optical) (manufacture)
131	77390	Scientific machinery rental and operating leasing
132	26200	Servers and network servers (manufacture)
133	46510	Software (non-customised)
134	58290	Software (ready-made) publishing (except computer games publishing)
136	62090	Software disaster recovery services
137	62012	Software house
138	62090	Software installation services
139	18203	Software reproduction from master copies (manufacture)
140	62012	Software systems maintenance services
141	46520	Telecommunication instruments and apparatus
142	61100	Telecommunication network maintenance (wired telecommunications)
143	46520	Telecommunications equipment
144	47429	Telecommunications equipment other than mobile telephones
145	46520	Telecommunications machinery, equipment and materials for professional use
146	61300	Telecommunications satellite relay station
147	27320	Telecommunications wire (manufacture)
148	61100	Teleconferencing services (wired telecommunications)
149	61100	Telegraph communication
150	61100	Telephone communication (wired telecommunications)
151	61100	Telex service (wired telecommunications)
152	42220	Urban communication and power lines construction
153	61900	VOIP (voice over internet protocol) provision
154	61200	Wireless telecommunications activities

## Appendix B: Cover letter sent with postal mail survey questionnaire

Date: 18/6/2012

Company address

### **Sub: Invitation to participate in a research survey on the role of Innovation Strategy in Business Growth**

Dear (Name of the participant)

My name is Roopa A.Nagaraju. I am a PhD student at the University of Bedfordshire. I am writing to ask you to participate in a survey that I am conducting to understand the role of Innovation strategy in the growth of the business.

As a participant, you will also receive an early Executive Summary of the results and you will have the opportunity to comment on the results.

All the data collected will be treated as confidential.

Please find the attached questionnaire for the survey.

Thank you very much in advance for your participation.

Yours sincerely,

Roopa A.Nagaraju

PhD Researcher

*Should you wish not to participate in this research then please email: [roopa.nagaraju@beds.ac.uk](mailto:roopa.nagaraju@beds.ac.uk) stating 'no thank you, I do not want to participate' and your details will be removed from our database.*

Appendix C: Questionnaire (Final version)

**The survey to identify the role of innovation strategy in the  
business growth of high tech SMEs**

**University of Bedfordshire  
Business and Information Systems Research Centre  
2012**

**Please return your completed questionnaire in the enclosed envelope**

# Informed Consent Form

*All responses to this questionnaire will be treated as confidential and any data collected in the study will be used for the purpose of this study. Details about the respondents and the company will be anonymised.*

**Purpose of the Study:** The purpose of this study is to examine how the business growth of small and medium high-tech companies are affected by the factors involved in an innovation strategy. The survey questionnaire will take approximately 10 minutes to complete and it includes information on the participant and the company participating, and five sections on technology factors, marketing factors, entrepreneurial factors, risk appetite/ business environment and business growth.

**Benefits of this Study:** By participating in this study you will be contributing to create knowledge on the role of innovation strategy in the business growth of small and medium high technology companies. As a thank you, you will receive a summary of this study, if you wish to have one.

**Confidentiality:** Your participation in this research will be kept confidential and data will be analysed and reported in aggregate. The collected data from this study will be stored electronically in a password protected folder and hard copy will be stored in a locked filing cabinet. The standard procedure of the University of Bedfordshire will be followed to destroy the data stored as per the policy.

**Decision to withdraw at any time:** Your participation is completely voluntary and you have the right to terminate or withdraw your participation at any time.

**Contact information:** If you have any concerns or questions about this study, please contact:

Miss.Roopa Nagaraju  
BMRI  
University of Bedfordshire Business School  
Luton campus (Vicarage Street)  
Luton  
Bedfordshire  
United Kingdom – LU1 3JU

Email: [roopa.nagaraju@beds.ac.uk](mailto:roopa.nagaraju@beds.ac.uk)

Phone:01234 400400 Extn:2128

**Please use the stamped and addressed envelope provided to  
return the questionnaire.**

*All responses to this questionnaire will be treated as confidential and any data collected in the study will be used for the purpose of this study. Details about the respondents and the company will be anonymised.*

*Please provide details of the company and the respondent*

0.1	Name of the Company	
0.2	Name of the respondent (optional)	
0.3	Job title of the respondent	
0.4	Year of the company started	
0.5	Number of employees at the start of the company	
0.6	Number of employees – Current year	

**Definition of Innovation:**

There are essentially four types of innovation identified in the Oslo Manual for measuring innovation: *product innovation*; *process innovation*; *marketing innovation* and *organisational innovation*. (OECD, 2005)

**Product Innovation:**

This involves a good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.

**Process Innovation**

Process innovation involves a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.

**Marketing Innovation**

Marketing innovation involves a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

**Organisational Innovation**

Organisational innovation involves introducing a new organisational method in the firm's business practices, workplace organisation or external relations.

The above-mentioned innovations can be new to the firm, new to the market/sector or new to the world.

**The above-mentioned innovations can be new to the firm, new to the market/sector or new to the world.**

Please select the appropriate box which is on the scale of ‘strongly disagree’, to ‘does not apply’

### Section 1 – Technological Factors

	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Does not apply
1.1	A majority of our innovations are based on substantially a core technology never used in our industry before	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2	A majority of our innovations involve technology that makes old technologies obsolete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3	A majority of our innovations use new technologies that permit quantum leaps in performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4	A majority of our innovations use technologies that have an impact on or cause significant changes in the whole industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5	A majority of our innovations use technologies which represent minor improvements over previous technologies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Section 2 – Market Based Capabilities

	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Does not apply
2.1	The majority of our innovations address completely new customer benefits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.2	The majority of our innovations offer our customers unique advantage over competitors’ products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.3	The majority of our innovations require changes in established attitude and behavioral pattern from our customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.4	Our mainstream customers require major learning efforts to use majority of our innovations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Does not apply
2.5	The majority of our innovations involve high switching costs for our mainstream customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.6	The majority of our innovations are similar to our main competitors' products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.7	We have the ability to introduce new products more quickly than our competitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.8	We have the ability to customize products to individual customers' needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Section 3 –Entrepreneurial Factors

	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Does not apply
3.1	The CEO is involved in new product/service development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2	The CEO is committed to building relationships with employees and there is mutual support and trust	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3	The CEO has previous experience with product/services development alliances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4	The company makes innovation happen through strong clear vision	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.5	There is a long term commitment to innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.6	There is a clear allocation of the resources for the implementation of innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7	The CEO encourages change and creates the right climate for the implementation of innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



#### Section 4 – Risk Appetite/Business environment

	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Does not apply
4.1	The market has been hostile and unpredictable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2	We have constantly introduced new products and services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3	When considering business opportunities we prefer a low risk with moderate return to a high risk opportunity with high return	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4	We actively nurture the relationship with our existing customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.5	We actively monitor our competitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.6	Our competitors have the ability to introduce new products more quickly than us	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.7	We regularly need to make changes to our business operations because of changes to government regulations with regard to :						
	Tax benefits of the company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Government funding for R&D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Foreign direct investment regulations and restrictions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Import / Export benefits and restrictions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Intellectual laws which make companies liable to follow the new standards set by government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Section 5 – Business Growth

	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Does not apply
5.1	We have expanded our market share consistently in the last five years	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.2	There has been a constant increase in the number of employees of the organization in the past five years	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.3	We have increased our assets constantly in the last five years	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.4	There is a constant increase in the return on our investment in the last five years	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.5	We are confident of doubling our financial turnover in the next five to ten years	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Thank you for completing our questionnaire.**

*Should you have any further questions or concerns about this survey or any of its questions, please contact:*

*Roopa A.Nagaraju at 01234 400400. Extn. 2128 or roopa.nagaraju@beds.ac.uk*

*Everyone who completes a questionnaire will receive an Executive Summary of the results.*

*If you wish to be removed from our database for this research please indicate here. ☐*

*Please use the stamped addressed envelope provided to return the questionnaire.*

## Appendix D: Reminder Letter to follow up on the participation

Date: 9/7/2012

Company address

**Reference: Reminder - Invitation to participate in a research survey on the role of Innovation Strategy in Business Growth**

Dear (Name of the participant)

Two weeks ago I sent you a questionnaire requesting your participation in a research study on the role of innovation strategy in business growth. A stamped addressed envelope was included for the questionnaire's return. If you have already completed and mailed back the questionnaire, please accept our sincere thanks. If not, I very much appreciate your time in completing the questionnaire, which will take about 10 minutes.

In my study, I seek your valuable expertise in order to help us to assess the role played by various factors involved in an innovation strategy in the business growth of high technology SMEs. Outcomes of the survey will be used to create knowledge about the important actors of the innovation strategy that will push the business growth in a positive direction in a high technology SMEs. Gathered data will be treated as confidential.

We appreciate your time and consideration in replying to this letter. All participants will receive an early Executive Summary of the results.

If you have already forwarded the questionnaire to someone else in your company for completion, please forward this letter too.

Thank you for your time and consideration.

Yours sincerely,

Roopa A.Nagaraju  
PhD Reseacher  
Business and Management Research Institute  
University of Bedfordshire Business School  
Luton campus (Vicarage Street)  
Luton - LU1 3JU  
Email: [roopa.nagaraju@beds.ac.uk](mailto:roopa.nagaraju@beds.ac.uk)  
Phone:01234 400400 Extn:2128

*Should you wish not to participate in this research then please email: [roopa.nagaraju@beds.ac.uk](mailto:roopa.nagaraju@beds.ac.uk) stating 'no thank you, I do not want to participate' and your details will be removed from our database.*

## Appendix E: Copy of an email sent with online questionnaire link

Dear Mr/Ms. (Name of the participant),

My name is Roopa Nagaraju and I am currently a doctoral student at Business School, University of Bedfordshire. I came across your contact details on \_Connect forum (Technological Strategy Board).

I am conducting an online survey to understand the role of innovation strategy in business growth. The survey is expected to take up to 10 minutes of your time, and I hope that you would kindly agree to participate in the survey and contribute data to the knowledge development.

As a thank you, you will receive an executive summary of the outcomes of my research work.

This is an anonymous survey and all data will be treated confidentially. You can complete the survey without disclosing name of the company and your name (Optional). Data analysis and findings will be based on aggregated and summarized data. The data will be used only for the purpose of this study.

The Survey questionnaire can be accessed at the following link:

[https://bedsbusiness.eu.qualtrics.com/SE/?SID=SV\\_57oM6o91Vyc1heR](https://bedsbusiness.eu.qualtrics.com/SE/?SID=SV_57oM6o91Vyc1heR)

Your participation is highly appreciated and it will make a significant contribution to the study of innovation strategy.

Yours sincerely,

Roopa A.Nagaraju

Doctoral student

Business School

University of Bedfordshire

Luton, UK, LU1 3JU

Email: roopa.nagaraju@beds.ac.uk

Mobile: 07443332858